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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

May Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, May 1, 1897.

The May meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York city, at 3 P.M., of the 13th inst.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

Twentieth Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., April 13th, 1897.

The 20th annual meeting of the Western Gas Association will be held at Cincinnati, O., May 19th, 20th and 21st, 1897, and will be called to order by the President, Mr. W. H. Odiorne, at 10 A.M., Wednesday, May 19th.

The meeting of the Board of Directors will be held at 10 A.M., Tuesday, May 18th. The following are Directors: Messrs. A. W. Littleton, Geo. H. Harper, Peter Young, Wm. Steinwedell, O. O. Thwing, I. C. Copley, C. W. Blodget, H. W. Douglas, James Forbes.

The Grand Hotel has been selected as the headquarters for the members, and the sessions of the Association will be held in a suitable room contained therein. A rate of $3 per day, American plan, has been obtained; rooms with bath, extra. Those who desire cheaper rates can obtain them at the Palace Hotel, located on Vine and Sixth streets; rates, $2 to $2.50 per day; or at the Hotel Emery, European plan only, rooms, $1, $1.25 and $2 per day. It is advisable that all write and reserve their rooms in advance of the meeting.

The Executive Committee have arranged for the presentation of the following papers:

"Revivification of Oxide of Iron in Purifiers," by Mr. I. C. Baxter, Detroit, Mich.

"The Failure of the Commercial Attempts to Supply Fuel Gas in the United States," by Mr. F. H. Shelton, Chicago, Ills.

"Selling Gas," by Mr. I. C. Copley, Aurora, Ills.

"Leakage," by Mr. E. H. Jenkins, Covington, Ky.

"An Oil-Tar Separator and Its Results," by Mr. John R. Lynn, Detroit, Mich.

"The Welsbach Incandescent Gas Light for Utility and Economy in Street Lighting," by Mr. H. Wilkiemeyer, Evansville, Ind.

"Wrinkle Department," edited by Mr. Geo. Treadway Thompson, New York.

Mr. F. Egner, who is now in Europe investigating inclined retorts, or "slopers," will send a communication giving the results of his investigations.

The Central Passenger Association, Trunk Line, Southern Passenger Association, and the Chicago and Alton, from all points in Illinois, have granted rates of 1½ fare for the round trip, conditional on 100 certificates being presented to the Secretary for indorsement. The territory embraced by the above Associations includes all States east of the Mississippi river, except New England, and Wisconsin.

All persons attending the meeting will purchase a first-class ticket at starting point, paying full fare for same, obtaining from agent a certificate stating that the person whose signature appears on same has purchased at full tariff fare one first-class ticket to Cincinnati, which certificate, after it has been signed by the Secretary of the Association and a representative of the above Passenger Associations, will entitle the purchaser thereof to a one-third rate returning home.

All persons obtaining reduced rates must apply to agent at least 30 minutes before departure of train. All station agents do not have a supply of certificates, but they may be obtained by request, if notification is made in time. Persons outside the territory embraced by Passenger Associations mentioned above should purchase a ticket to nearest point within said Association, and from there purchase a ticket to Cincinnati, obtaining a certificate which will entitle them to a one-third fare returning to place from which certificate was obtained.

All queries sent to the Secretary for the Question Box will be assigned to members for answers.

A cordial invitation is extended to members of other Associations to meet with us, and to participate in the discussions of papers presented.

The Secretary will be pleased to answer any communications pertaining to the meeting, and will mail blank applications to any who desire to become members of the Association.

JAMES W. DUNBAR, Secretary.

BRIEFLY TOLD.

CHANGE OF OFFICE ADDRESS OF THE SECRETARY OF THE AMERICAN GAS LIGHT ASSOCIATION.—Mr. Alfred E. Forstall, Secretary of the American Gas Light Association, informs us that all communications meant for him, either on account of the business of the Association, or for his personal account, should be thus addressed: "A. E. Forstall, care of the Montclair Gas and Water Company, Montclair, N. J."

THE PHILADELPHIA GAS WORKS, FROM A LEGISLATIVE POINT OF VIEW.—The special committee appointed by the Pennsylvania Senate to investigate the municipal affairs of Philadelphia, which committee has been carrying out that task in a desultory sort of way for perhaps two years, has handed in its report. In other issues of the JOURNAL have been given some statement of the testimony had before the committee in its probings into the operation of the Philadelphia municipal gas works, and the findings of the report in that instance are, to say the least, quite in unison with the testimony of the experts who, during the investigation, testified that the gas supply of the city was being woefully maladministered. We have not yet received a complete copy of the report, but the excerpts furnished the daily press are ample to show that the committee found much in the system to condemn. For instance, the report declares: "The manufacture and sale of illuminating gas is clearly not in and of itself a governmental function, but is a business usually carried on by private corporations, which has enlisted in its prosecution the best engineering and technical skill and business ability, and the city has failed to achieve results which private management would be compelled to do for its own self-preservation and to secure adequate returns to its stockholders." Continuing, it is said that although the quality supplied is deficient, the consumption steadily increases. Only two-thirds of the householders use gas, and the committee shows that these gas consumers not only bear the burden of the public lighting, but also of 1,000,000,000 cubic feet absolutely lost through imperfect works and pipes. The committee also recommends the immediate sale or lease of the city's gas works, or else the investment of sufficient additional capital to put the plant in a state of practical utility. What have Messrs. Cross and Bemis to say to that arraignment of municipal ownership?

DEATH OF MR. ELBRIDGE G. SPAULDING.—Mr. Elbridge Gerry Spaulding, for over a third of a century the President and Treasurer of the Buffalo (N. Y.) Gas Light Company, and its principal owner, died at his home in Buffalo on the afternoon of the 5th inst. He was born at Summer Hill, Cayuga county, N. Y., February 24, 1809, and eventually settled in Buffalo, where he practiced law, until 1850, in which year he engaged in the banking business. He served the city of Buffalo as its City Clerk, and afterwards as Mayor. He next represented a district of Buffalo in the State Assembly. In 1848 he was elected to Congress, and in 1853 he was elected Treasurer of the State of New York. In 1858 and in 1860 he was again elected to Congress, and served on the Committee on Ways and Means during the two terms. At this period of his labors he framed the Greenback or Legal Tender bill and the National Currency banking measure, both of which became laws. He was a safe, conservative man, who had opinions, gave expression to them and held to them. His estate is well into the millions.

DEATH OF MR. CHARLES S. ALLMAND.—We regret to report the death of Mr. Charles S. Allmand, for many years prominent in the executive management of the City Gas Light Company, of Norfolk, Va. His death occurred on the evening of April 26th, at his home on East Main street, Norfolk. He was in his 81st year, and the greater part of his quiet, useful life was passed in Norfolk. He was Chairman of the Board of Stewards of the Cumberland street Methodist Episcopal Church, and the correspondent who informed us of his death closes that mention in these words: "He was a consistent Christian in every sense of the word, and his death is a source of the deepest regret to a host of friends."

NOTES.—The Alexandria (Ind.) Gas Company has been formed with a capital of $40,000.——The proprietors of the Middletown (Conn.) Gas Light Company have reduced the rate for a fuel gas supply to $1.40 per 1,000 cubic feet.——At the annual meeting of the Erie (Pa.) Gas Company the following officers were chosen: Directors, Chas. M. Reed, G. R. Metcalf, Wm. Spencer, Wm. S. Brown, J. P. Metcalf, Chas. Brandes and Paul Mueller—the latter succeeds the late Capt. J. S. Richards; President, C. M. Reed; Treasurer, G. R. Metcalf; Secretary, Paul Mueller; Superintendent, M. N. Hill.

[Prepared for the JOURNAL.]

Locating, Determining and Laying of Street Mains and the Distribution of Gas.—No. II.

By MR. J. P. GILL.

These surveys are made with an ordinary engineer's leveling instrument, the distances being measured and recorded between the points at which levels are taken, and also from some fixed, well-known and described points, such as the corners of the streets, the foundation of buildings, or stone work, or other permanent monuments, being fixed reference points, so that the system can be picked up at any location and at any time. Care must be taken that the "datum," or point of reference, or starting point of the system, shall be below the lowest depression in the street or line of pipes, that there may not be any minus or negative numbers required when making this record. If the town has not made such a system of elevations, and established "benches" or permanent and described points at convenient places, of which the elevations are recorded, such a system may be run by the company's engineer.

In that case, as for an instance among others, a permanent point may be selected on the base of one of the columns of the gasholder, for the "datum" or point of reference. This point, wherever situated, must be lower than the lowest level of the street mains; if not, an imaginary point or level must be assumed, 5, 10, or any proper number of feet below the top of the tank, which point will be the "datum" of reference, and the level of the selected point on the tank will be 5, 10, or other number of feet in elevation; and from this bench so established and recorded, the elevation above "datum" of all other benches will be calculated. From these benches, carefully described and recorded, the leveling can be resumed and continued at any subsequent time, and other elevations, as above named, be ascertained.

Let there be a line of pipe laid the length of two blocks, each 400 feet long, on the east side of a street called Chestnut avenue, and running north of 3d street, and let the proper elevations be taken by the leveling instrument. The record of a bench near that corner, which was previously located and recorded, gives its elevation above "datum" as 25.40 feet. The leveling instrument is now set at a convenient place and a backsight is taken to the bench, and it is found that the level of the instrument is 8 feet above the bench. The instrument is now turned sufficiently to take a foresight to some fixed point at or near the corner of the streets for a "turning point." It is found that this point is 10.30 feet below the level of the instrument, *i.e.*, 2.30 feet below the bench, making the elevation of the turning point 23.10 feet above "datum" (Fig. 8).

Fig. 8.

The leveling instrument may then be taken up and set at some convenient place on Chestnut avenue, but it is not in this instance, the points being in sight. The following successive elevations and grades of the street over the pipe are found. The pipe begins at a cross at the southeast corner of the avenue and 3d street.

Thus the end is 1.80 feet higher than the beginning. The pipe is run on the average 10 feet out from the curb, but at 550 feet from the commencement an inlet to a sewer is met which diverts the pipe 3 feet nearer the curb at that point. At 500 feet is a sleeve. (Fig. 9.)

The record in the "field book" will be as follows. The table below is a copy of a page in books which have been in use some years, and which contains a full and satisfactory record of the elevations and measures. The abbreviations used are:

B. indicates bench or permanent point of elevation.
St. " station where turning points, etc., are made.
T.P. " turning point; to which fore and backsights are taken when the instrument is moved, and which may be required for only a temporary purpose.
B.S. " backsight to a bench or T.P., when commencing to take levels.
F.S. " foresight to any point of which the level is then required.
R. " rise of grade.
F. " fall of grade.

At R.A. means measuring to the pipe from the curb or line of street,

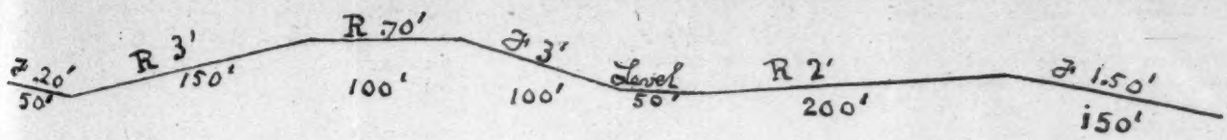

Fig. 9.

extended if necessary, at "right angles" to the curb, etc., thus giving the distance out of the pipe.

"In line with pipe" means measuring from a given point the length of the pipe over the line of pipe or parallel thereto. In the record 10.30 means 10 feet and 30 hundredths of a foot, which is the height given on the leveling rod.

"Street elev." means elevations made of points in the streets, and of benches and turning points wherever they may be.

FIELD BOOK.

Six-Inch Main on Chestnut Ave., E. sd. from + S.E. cor. 3d st. Street bet. Curbs, 60 ft.	Sta.	Distance out of Pipe, etc.			T. P. Elev. and Bench.	Str. B. S.	Instr. Elev.	Str. F. S.	Pipe F. S.	R.	F.	Str. Elev.	Pipe Elev.	Length, Feet.
		At R. A.	In Line with Pipe.											
Bench					25.40									
T. P. at S.E. cor.	A					8.00	33.40	10.30			2.30	23.10		0
Street at +								10.80			.50	22.60		0
Pipe at N. end of + S.E. cor. 3d st		10	5	N of S C					14.60				18.80	0
Street at 50 ft. N.			5	S N C				11.00			.20	22.40		50
Pipe " "		10	"	"					14.20	.40			19.20	"
Street, 145 ft. N.N.C.								8.00		3.00		25.40		150
Pipe, " "		10							11.00	3.20			22.40	"
Street, 245 ft. N.N.C. 3d st	B							7.30		.70		26.10		100
Pipe, " " "		10							10.30	.70			23.10	"
Change of Instr					26.10	4.00	30.10							
Street, 5 ft. N.S.C. 4th st								7.00			3.00	23.10		100
Pipe, do., at. N. end of +, grade right		10	5	N S C 4th st					10.00		3.00		20.10	"
Street, 5 ft. S.N.C. 4th st			5	S N C				7.00			0	23.10		50
Pipe, do., drip here		10	"	"					10.60		.60		19.50	"
Street, 45 ft. N.N.C. over sleeve								6.50		.50		23.60		50
Pipe, do., S. end of sleeve		10	45	N.N.C.					10.00	.60			20.10	"
" " N. " "		"							9.90	.10			20.20	
" 95 ft. N.N.C.		7												
Street, 195 ft. N.N.C								5.00		1.50		25.10		150
Pipe, do.		10							8.00	1.90			22.10	"
Street, 5 ft. N.S.C. 5th st								6.50			1.50	23.60		150
Pipe, do., S. end of + S.E. cor. 5th st		10	5	N.S.C. 5th st					9.50		1.50		20.60	"
At 95 ft. N.S.C. 4th st—an obstruction; an opening to a sewer. Pipe curves 75 ft. each way.														
														800

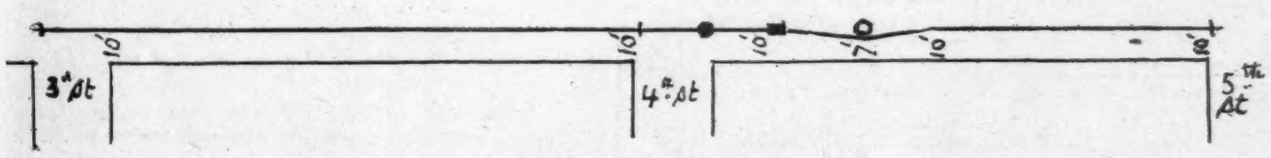

Fig. 10.—Plan, E. Side of Chestnut Ave.

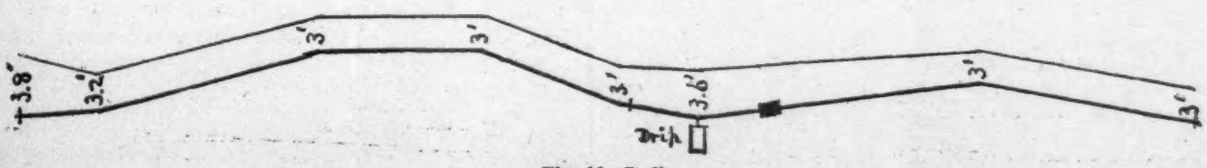

Fig. 11.—Profile.

"Pipe elev.," those taken on the pipes.

——▬—— signifies the place of a sleeve.

Elevations of the pipe should be taken at both ends of branches, sleeves, reducers and other specials, to make sure that they have the right grade.

C. indicates curb.

N.S.C. " north of south curb.

E.W.C. " east of west curb, etc.

All obstacles, as gas or water pipes, sewers, electric subways, entrances to either, or any other works under ground, which cause a change of grade or direction, should be plotted on the profile maps and plans, for a permanent record of the reason why and the way in which they were made.

In illustration of the method of making the preliminary exploration and of determining the location and sizes of the gas pipes which may be required to be laid, the town selected for an example is supposed to be located on the left or north bank of a river running from the west easterly, and to occupy a territory three miles square, viz.: Three miles parallel to the river and three miles on rising ground in a northerly direction. For the first 900 yards there is a rise of 25 feet, in the next 3,500 yards a rise of 240 feet and in the last 900 yards a rise of 45 feet, making a total rise of 310 feet in the 3 miles (Fig. 12).

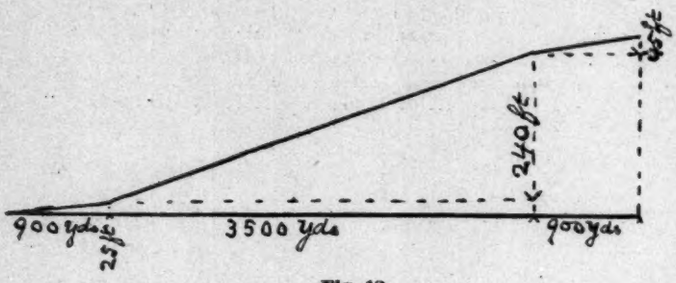

Fig. 12.

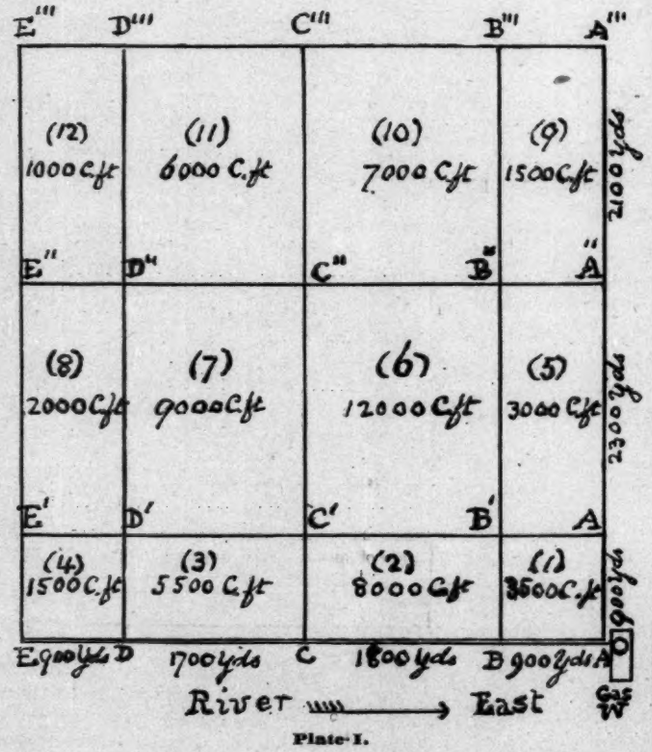

Plate I.

The streets in the direction of A to E run parallel to the river, and those in the direction of A to A''' run northerly. The blocks or squares parallel to the river are about 300 yards long from center to center, and those parallel to A A''' about 90 yards long from center to center.

The town is found to have a consumption, actual and prospective during the shortest days in winter, of 60,000 cubic feet per hour, and it may be divided into twelve districts numbered from (1) to (12). The districts are estimated to consume hourly, as follows:

No. 1.	3,500	cubic	feet.	No. 7.	9,000	cubic	feet.
" 2.	8,000	"	"	" 8.	2,000	"	"
" 3.	5,500	"	"	" 9.	1,500	"	"
" 4.	1,500	"	"	" 10.	7,000	"	"
" 5.	3,000	"	"	" 11.	6,000	"	"
" 6.	12,000	"	"	" 12.	1,000	"	"

Total, 60,000 cubic feet.

The consumption of districts 1, 5, 9, is.....	8,000	cubic	feet.
" " " 2, 6, 10, is.....	27,000	"	"
" " " 3, 7, 11, is.....	20,500	"	"
" " " 4, 8, 12, is.....	4,500	"	"
Total,	60,000	"	"

The length from A to B is.....	900	yards.
" " B to C is.....	1,800	"
" " C to D is.....	1,700	"
" " D to E is.....	900	"
" " C to C' is.....	900	"
" " C' to C'' is.....	2,300	"
" " C'' to C''' is.....	2,100	"

The flow of gas through the mains in the respective districts per hour will be:

From	Cubic Ft. Passing thro' the Former District.	Local Consumption		Gas Passing through Districts. Cu. Ft.	Length. Yards.	Passing District.
		Cu. Ft.	Supplying Districts.			
A to B....	.....	.....	.....	60,000	900	No. (1)
B to C....	60,000	8,000	(1), (5), (9)	52,000	1,800	" (2)
C to D....	52,000	47,500	(2), (6), (10) (3), (7), (11)	4,500	1,700	" (3)
B to B'....	.....	.....	.....	8,000	900	" (1)
B' to B''..	8,000	3,500	(1)	4,500	2,300	" (5)
B'' to B'''..	4,500	3,000	(5)	1,500	2,100	" (9)
C to C'....	.....	.....	.....	47,500	900	" (2) & (3)
C' to C''...	47,500	13,500	(2), (3)	34,000	2,300	" (6) & (7)
C'' to C'''.	34,000	21,000	(6), (7)	13,000	2,100	" (10) & (11)
D to D' ...	.....	.....	.....	4,500	900	" (4)
D' to D''..	4,500	1,500	(4)	3,000	2,300	" (8)
D'' to D'''.	3,000	2,000	(8)	1,000	2,100	" (12)

This table is formed on the supposition that the pipe from B to B''' supplies the three districts, 1, 5, 9: the pipe from C to C''', the six districts, 2, 3, 6, 7, 10, 11; and that from D to D''', the three districts, 4, 8, 12.

With these preparatory steps, the calculations may be made to ascertain the diameters of the pipes and the pressures at the commencement and termination of each size of pipe. This has the appearance of being very difficult, if not impossible; yet it is comparatively easy to do, a knowledge of multiplication, division and the extraction of the square root being only required. A couple of examples will be sufficient to enable anyone to extract the square root of any number.

Let it be required to find the square root of 576. Separate the number into periods of two figures each, beginning at the unit or right hand figure. The left hand period will contain one or two figures, according as the proposed number consists of an odd or even number of figures.

576(24
4

1st trial divisor ..... 40)176 = 1st dividend.
1st divisor..... 44)176

...

Proof: 24 × 24 = 576

Subtract from the left hand period the largest square number contained in it, which can be found by the inspection of the following table, or by any table of squares and square roots, or by mental arithmetic.

Root.....	1	2	3	4	5	6	7	8	9
Square...	1	4	9	16	25	36	49	64	81

Place the root on the right hand of the original number as in common division, and to the remainder brought down annex the second period; this will be the first dividend.

Double the root already found and place it on the left of the first dividend and annex a cipher for the first trial divisor; see how many times this divisor is contained in the first dividend. The quotient will be the second figure of the root, which is to be placed at the right of the root

already found, and also to be added to the first trial divisor; the result will be the true divisor. Multiply this by the last figure of the root and subtract the product from the first dividend, and to the remainder annex the next period for the second dividend. Continue in this manner until all of the periods are brought down.

Find the square root of 128522.25.

$$\begin{array}{rrrl} & & 128522.25(358.5 & \\ & & 9 & \\ \hline \text{First trial divisor}..... & 60 & 385 & = \text{1st dividend.} \\ \text{1st divisor}..... & 65 & 325 & \\ \hline \text{2d trial divisor}..... & 700 & 6022 & = \text{2d} \quad \text{“} \\ \text{2d divisor}..... & 708 & 5664 & \\ \hline \text{3d trial divisor}..... & 7160 & 35825 & = \text{3d} \quad \text{“} \\ \text{3d divisor}..... & 7165 & 35825 & \\ \hline \end{array}$$

Proof: $358.5 \times 358.5 = 128522.25$

A decimal is obtained here for the sake of an illustration, but decimals are not always required.

A table of the 5th powers of numbers is needed from 2 to 36 or more, including the usual diameters of pipes. Tables of the 5th powers are to be found in a number of pocket books of reference and in mathematical works. The following will answer every purpose, of which a copy may be made for easy reference. While using this table, the only precaution to be observed is that, whenever a number is given or obtained by calculation of which the 5th root is wanted and which is larger than a power given in the table (*i. e.*, when it is between two given powers), the smaller root should not be used for the diameter of the pipe, but always the next larger root or diameter. This is necessary in order to avoid too great a loss of pressure by the greater friction caused by the flow of gas through the smaller pipe. This loss of pressure might be disastrous. Examples will be given below.

Nr. (Root).	5th Power.	Nr. (Root).	5th Power.
2	32	20	3,200,000
3	243	22	5,153,632
4	1,024	24	7,962,624
5	3,125	26	11,881,376
6	7,776	28	17,210,368
8	32,768	30	24,300,000
10	100,000	32	33,554,432
12	248,832	34	45,435,424
14	537,824	36	60,466,176
16	1,048,576	42	130,691,232
18	1,889,568	48	282,475,249

The formulas required for ascertaining the quantity of gas delivered, the diameters of the pipes, and the pressures at any given points, are as follows:

$$\text{(A)} \quad Q^2 = \frac{D^5 H}{.0000006s(L+D)} = \frac{D^5 H}{.0000006s\,L} \qquad \text{For Short Distances. For Long Distances.}$$

$$\text{(B)} \quad D^5 = \frac{.0000006s\,Q^2(L+D)}{H} = \frac{.0000006s\,Q^2 L}{H}$$

$$\text{(C)} \quad f = \frac{.0000006s\,Q^2 L}{D^5}$$

$$\text{(D)} \quad H - f = h$$

in which, Q is the quantity delivered in cubic feet per hour.

H is the initial pressure in inches of water.

D is the diameter of the pipe in inches.

L is the length in yards.

s is the specific gravity of the gas.

f is the pressure lost by friction, resulting from the passage of the gas through the pipe.

h is the pressure of gas at the end of any given length of the pipe.

To multiply by the constant decimal, .0000006: Multiply by 6 and mark off 7 decimals on the right of the product; $25873492 \times 6 = 15.5240952$, a little over 15½.

To divide by .0000006: Divide by 6, the dividend being carried to 7 places of decimals; the quotient will be a whole number; a decimal, if any, in the answer beyond the whole number obtained as above, may as a rule be omitted, not usually being needed.

Divide 537.2657 by .0000006.

$$6)\ 537.2657000$$
$$895442833.3$$

, the answer being 895,442,833.

Divide 537 by .0000006.

$$6)\ 537.0000000$$
$$895000000$$

, the answer being 895,000,000.

The quantity by equation (A) is equal to the square root of the quotient obtained as follows: Multiply the 5th power of the diameter, taken from the foregoing table, by the pressure, and call the product the reserved dividend. Multiply the length by the specific gravity and by the constant decimal .0000006; the product is the divisor by which the reserved dividend is to be divided. The square root of the quotient will be the quantity discharged.

In Plate I. there are four main supply pipes, one running from A to D, one from C to C‴, one from B to B‴, and one from D to D‴. The smaller pipes for the supply of the several districts will be considered hereafter. The longest length of the main supply pipe in a continuous length must be used, as will appear below. The pipe from A to C‴ is 8,000 yards long, and consists of 5 sections. From A to B is 900 yards long; from B to C is 1,800 yards long; from C to C′ is 900 yards long; from C′ to C″ is 2,300 yards long; and from C″ to C‴ is 2,100 yards long. The works are situated at the lower, southeast end of the town, on the river bank. The pipe from A to B, 900 yards long, supplies the entire consumption of the town, 60,000 cubic feet per hour, and with an initial pressure of 1 inch. The unit pressure of 1 inch is used, because the quantity of gas discharged with any other pressure can be easily calculated—viz., $1 : \sqrt{P'} :: Q : Q'$, and because the terminal pressures in the following calculations will be increased exactly with the additional pressure, with which the initial pressure may be increased, the quantity discharged remaining the same; for in both cases the loss by friction will be the same, which is proved by calculation as follows: Let the diameter of a pipe be 4 inches, the length 600 yards, the specific gravity being .5, and the quantity to be discharged 2,000 cubic feet per hour, with a pressure of 1 inch.

By formula (C): $f = \frac{.0000006s\,Q^2 L}{D^5} = \frac{.0000006 \times 5 \times (2{,}000)^2 \times 600}{1{,}024} = \frac{720}{1{,}024} = .7031$ inch. $1 - .7031 = .2969 = h$, the pressure at the end of the pipe; or by formula—

$$h = \frac{D^5 H - .0000006s\,Q^2 L}{D^5} = \frac{1{,}024 \times 1 - .0000006 \times .5 \times (2{,}000)^2 \times 600}{1{,}024} = \frac{1{,}024 - 720}{1{,}024} = \frac{304}{1{,}024} = .2969,$$

the same as above. Now let the initial pressure be increased by 1 inch, making it 2 inches, Q continuing to be 2,000 cubic feet, $h = \frac{1{,}024 \times 2 - 720}{1{,}024} = \frac{1{,}328}{1{,}024} = 1.2969$, the final pressure being also increased 1 inch. Thus, other terms remaining the same, the final pressure will be increased or diminished with the same quantity as the initial pressure.

Resuming the calculation, let the specific gravity of the gas supplied to the town be, say, .5 inch. Now as the total quantity of the gas supplied is 60,000 cubic feet per hour, passing through the length of 900 yards from A to B, what will be the diameter of the pipe that will pass that quantity through the entire length of the supply, 8,000 yards pipe, from A to C‴, the pressure being 1 inch?

[To be Continued.]

[Translated for the JOURNAL, by Mr. Herman Poole.]

The Utilization of Fuels.

By "R.," in *Le Genie Civil.*

Nature of Fuels.—The only fuels employed in manufacturing are carbon and hydrogen, and the compounds derived from these two elements. In a small number of special cases sulphur, phosphorus, silicon and certain metals serve as fuel, but the study of these exceptional circumstances must be reserved for metallurgy, while we will consider here only ordinary heating cases applicable either to steam boilers or other industrial uses.

Hydrogen and carbon are at times used in the uncombined state; the one in the gaseous form, the other solid. We will commence by considering these particular cases before touching the examination of the combustion of those compounds which occur as gases, liquids or solids.

We will pass over those chemical reactions of combustion where other elements than oxygen are concerned, but will confine ourselves to the consideration of its action, whether pure, mixed, as in air, or in combination with water.

Combustion of Hydrogen.—Of all known substances burnt in pure oxygen or in air, hydrogen develops the highest number of heat units per pound of combustible, 34,462 heat units, supposing all the water

produced to be reduced to the liquid state, and at 32° F.; if the 9 pounds of water produced remain in the state of vapor at 32° F., we must deduct from this number the latent heat corresponding to the evaporation at 32° or

$$9 \times 606.5 = 5,458.5,$$

and there remains for the calorific power of hydrogen under these circumstances

$$34,462 - 5,458.5 = 29,013.5;$$

or, in round numbers, 29,000.

The density of hydrogen being about, 0.0692 a cubic foot at 32° F., and at ordinary atmospheric pressure, weighs 0.0056 lb., and a pound of hydrogen under the same conditions occupies 178.8 cubic feet. To completely burn this quantity of hydrogen, 8 pounds of pure oxygen are needed, occupying a volume of 89.6 cubic feet, or an equivalent quantity of air, which would weigh 36 pounds and hence volume of 448 cubic feet. This would contain 28 pounds of nitrogen with a volume of 358.4 cubic feet.

The theoretical temperature of combustion for hydrogen with pure oxygen may be calculated by dividing the heat produced in oxygen by the specific heat of the aqueous vapor produced:

$$\frac{29,000}{9 \times 0.475} = 6,743° \text{ C. } (12,269° \text{ F.})$$

But the experiments of Bunsen and Sainte-Claire-Deville have directly shown that the temperature of the flame of hydrogen burnt in pure oxygen under atmospheric pressure does not exceed 2,500 C. (4,532° F.), and is increased to about 2,850° C. (5,162° F.) by a pressure of 10 atmospheres. This difference between the given result and the preceding calculation shows accessory and correlative phenomena, dissociation of the aqueous vapor, which consumes between 900° and 1,000° C. (1,652° and 1,832° F.) under ordinary pressure, and is nearly complete at 2,500° C. (4,532° F.) under ordinary pressure, or at 2,850° C. (5,162° F.) under 10 atmospheres pressure. In other words, the two gases which commence to combine at 800° C. (1,472° F.) begin to separate at 1,000° C. (1,832° F.), and these may occur side by side without reaction when the temperature reaches 2,500° C. (4,532° F.), unless subjected to a strong pressure.

The combustion of hydrogen in the air produces a temperature theoretically less elevated on account of the presence of nitrogen, the specific heat of which is 0.244 and the weight is relatively considerable. The calculation made above applies to the new case, thus:

$$\frac{29,000}{9 \times 0.48 + 26.34 \times 0.244} = 2,680° \text{ C. } (4,856° \text{ F}).$$

But here again the direct determination of Bunsen has fixed the true maximum temperature at only 1,800° C. (3,272° F.) Dissociation is more active in the dilute mixture of aqueous vapor and nitrogen than in aqueous vapor alone, because the presence of nitrogen plays the same role as the lowering of the atmospheric pressure by about one-third. The volume of aqueous vapor produced and that of the nitrogen under the same conditions of temperature and pressure, and at the instant of complete combustion, are in the proportion of the fractions

$$\frac{9}{0.287} \text{ and } \frac{26.6}{0.44}, \text{ or about } \frac{1}{2}$$

The difference between these numbers of theoretical and real temperature of combustion does not correspond to a loss of heat, but to the *formation of flame.*

Let us examine a jet of hydrogen thrown into the air in the vicinity of an ignited body. The explosive mixture commences to form, becomes heated by radiation from the ignited body (or from the flame already existing) until it reaches in a given point a temperature of from 700° to 800° C. (1,292° to 1,472° F.) necessary for the explosion. The flame commences at this place; its temperature increases a little further to 1,800° C. (3,272° F.), but does does not pass this point, because there the gases flow in parallel layers without being able to combine, or rather combining little by little in proportion as the radiation relieves the flame of its excess of temperature, and the flame is extinguished when the loss of heat becomes sufficient to reduce the temperature of the gaseous current to about 1,100° C. (2,012° F.). The flame is then the shorter the more rapid the loss of heat, and the burnt gases have a temperature of 1,000° C. (1,832° F.). They contain then a quantity of heat, available above 0°, without condensation, given by the formula—

$$x = 1,000 (9 \times 0.48 + 26.44 \times 0.244) = 10,820 \text{ heat units.}$$

In apparatus used industrially we generally utilize a portion of this heat, which is at least about one-third of the total calorific power of the hydrogen. We can hardly push the utilization as far as condensation, but we can frequently arrive at 250° C. (482° F.) for the limit of exit temperature for the waste gases. Consequently the total heat produced by this combustion may be considered as divided into four categories:

Available heat given off by the flame from 1,800° to 1,000° C. (3,272° to 1,832° F.)	18,183.5	29,013.5
Heat of waste gases from 1,000 to 250° C. (1,832° to 482° F.)	8,125.0	
Heat carried away by waste gases at 250° C. (482° F.)	2,705.0	
Heat condensation of aqueous vapor at 0° C. (32° F.)	5,458.5	

The form even of the flame, and in consequence also the rational form of furnaces used, may be deduced from the preceding remarks.

Let us take, for example a pipe 0.10 m. (3.9 inches) diameter, emitting hydrogen into a furnace under the low pressure of a ventilator or ordinary draft; surround this with a second pipe serving for the admission of air, similarly under low pressure. The orifices of the two pipes may be to each other as the volumes 11.2 and 26.8, which would give, for the admission of the air, an exterior diameter of—

$$D = d\sqrt{\frac{11.2 + 26.8}{11.2}} = .10\sqrt{3.31} = 0.182 \text{ m. } (7.16 \text{ inches}).$$

The mixture of gas commences at the opening of the pipes and expands by the radiation of the heat nearly in arithmetical progression, until the temperature reaches 800° C. (1,472° F.), at which point the flame begins; the volume is then almost quadruple $1 + 800 \times .00365 = 3.92$, and, to keep a nearly uniform condition, the section of the furnace should increase in the same proportion. If it is circular its diameter should become—

$$0.182 \times \sqrt{3.92} = 0.36 \text{ m. } (14.17 \text{ inches}).$$

The combination of the gases commencing with the flame, there would be a tendency towards reduction of volume following the contraction from three volumes to two volumes, which occurs with a mixture of hydrogen and oxygen while changing to aqueous vapor; but there is a compensation due to the rapid elevation of temperature, and the total volume continues to increase up to 1,800° C. (3,272° F.), where, supposing the combination of the two gases very thorough, the value will be—

$$11.2 (1 + 18.00 \times 0.365) + 21.216 (1 + 18.00 \times 0.365) = 214 \text{ cubic meters}$$
(7,557.6 cubic feet,)

corresponding to a mean diameter of

$$0.10\sqrt{\frac{214}{11.20}} = 0.44 \text{ m. } (17\tfrac{1}{4} \text{ inches.})$$

This dimension is rapidly reached, is kept for a length dependent on the conditions of coaling, then diminishes rather quickly to the end of the flame, ending at about 1,000° C. (1,832° F.). The volume of the gas is then $2 + 3 (11.20 + 21.216) (1 + 1,000 \times .00365) = 150$ cubic meters (5,297.5 cubic feet,) and the orifice diameter corresponding—

$$0.10\sqrt{\frac{150}{11.20}} = 0.3 \text{ m. } (14.6 \text{ inches.})$$

The waste gases then cool down gradually to 250° C. (482° F.), the common temperature of exit, then to 100° C. (212° F.), at which point the condensation of aqueous vapor begins, and finally to 0° C. (32° F.) if allowed to go so far.

The circumstances accompanying the production of the flame and the subsequent cooling may be shown by the following diagram, where are shown the successive rational diameters of a furnace of circular section, and at the same time the successive temperatures are indicated.

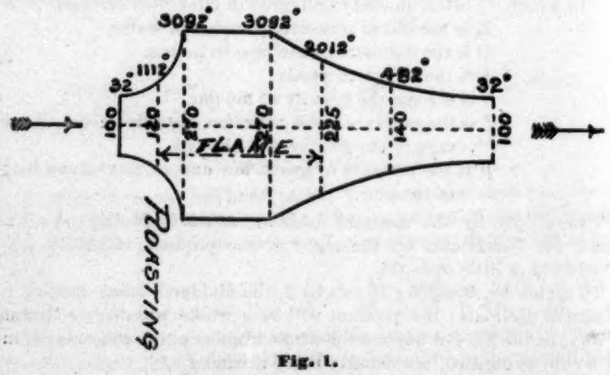

Fig. 1.

The section of the furnace is given as a double curve, but in practice we somewhat modify the curves to the interior by somewhat concave

curves for reflecting and concentrating the radiated heat to the central zone, where the reactions requiring the higher temperature are accomplished. This is the reverberatory furnace. On the contrary, we flatten the curves for operations needing more extended flames, such as in steam boilers or roasting furnaces.

Combustion of Carbon.—While carbon has a lower calorific power than hydrogen, it actually plays a role much more important in our furnaces.

A pound of carbon produces by its combustion, as may be easily predicted, somewhat variable amounts of heat, according to its molecular condition. These have been determined by Favre and Silbermann, as follows:

	Density.	Heat Units.
Diamond	3.5	7,770
Graphite	2.5	7,797
Retort carbon	1.9	8,047
Wood charcoal	1.6	8,080

These numbers applying to the total transformation of one pound of carbon into carbonic acid, but in reality the phenomena of combustion commence with the formation of carbonic oxide, and this gas burns in its turn to form carbonic acid.

To burn one pound of carbon and to make carbonic oxide of it needs ⅓ of a pound of oxygen, or 1.33 pounds of this gas, occupying a volume of 14.9 cubic feet, or 5.76 pounds of air occupying a volume of 71.83 cubic feet, in which the nitrogen weighs 4.43 pounds and measures 56.93 cubic feet. The product of combustion is carbonic oxide, weighing 2.33 pounds, and occupying a volume double that of the oxygen consumed, or 29.8 cubic feet.

In the case of air being used we must add to these numbers those corresponding to nitrogen, which would give a total weight of gas, 6.76 pounds, and a total volume of 189.3 cubic feet (reduced to 32° F.).

The quantity of heat developed by this incomplete combustion of carbon has been measured, and only reaches 2,473 heat units. The difference of 5,603 heat units would represent the heat lost by the apparatus, if we allow the carbonic oxide to escape without completing the oxidation.

The theoretical temperature of the combustion is calculated by using the specific heat of carbonic oxide, which is 0.245; and that of nitrogen, which is 0.244. We have then in case of carbon burnt to carbonic oxide in pure oxygen,

$$\frac{2{,}473}{2.33 \times 0.245} = 4{,}332° \text{ C. } (7{,}829° \text{ F.})$$

In reality we are far from reaching this number, and it shows that some 2,500° C. (4,532° F.) is lost by dissociation.

Combustion in the air would give

$$\frac{2{,}473}{2.33 \times 0.245 + 4.43 \times 0.244} = 1{,}500° \text{ C. } (2{,}732° \text{ F.})$$

And in this case there seems to have been no notable dissociation; that is to say, the real temperature attained is near the theoretical temperature. There can then be no flame.

Let us now examine the case of complete combustion, where the carbon is oxidized to carbonic acid. To burn the one pound of carbon ⅔ (or 2.66 pounds) of oxygen are needed. This occupies a volume of 31.8 cubic feet, or if air is used, we must add 8.86 pounds, and 119 cubic feet for nitrogen, making a total volume of 150.8 cubic feet of air. The volume of the gases reduced to 0° C. (32° F.) is not changed by combustion, but the weight is increased by that of the carbon burnt. We will calculate the theoretical temperature of combustion as above, but taking account of the specific heat of carbonic acid, which is 0.22, and of the total calorific power 8,080 heat units, we then have for the combustion of carbon in pure oxygen

$$\frac{8{,}080}{3.66 \times 0.22} = 10{,}000° \text{ C. } (18{,}032° \text{ F.})$$

But here the dissociation of carbonic acid acts powerfully. At about 1,100° C. (2,072° F.) this gas begins to decompose into oxygen and carbonic oxide, and carbonic oxide in its turn decomposes at a higher temperature not exactly determined. St. Claire-Deville's direct experiments point to about 2,600° C. (4,712° F.) as the absolute maximum temperature of the combustion of carbon in pure oxygen.

Combustion in air gives

$$\frac{8{,}080}{3.66 \times 0.224 + 8.86 \times 0.244} = 2{,}723° \text{ C. } (4{,}934° \text{ F.})$$

But dissociation acts here more energetically, on account of the presence of nitrogen which diminishes the relative tension of the carbonic acid and the actual temperature does not seem to exceed 1,800° C. (3,272° F.).

It now remains to examine by itself the second phase of the combustion, that of carbonic oxide burnt to carbonic acid in pure oxygen or in air. The calorific power of 1 pound of carbonic oxide is 2,403 heat units; but 1 pound of carbon forms 2.33 pounds of carbonic oxide, having a total calorific power of 5,603 heat units, and requiring for its combustion 1.33 pounds of oxygen, or 14.9 cubic feet; or else 5.76 pounds air, occupying a volume of 71.83 cubic feet, and containing 4.43 pounds of nitrogen, with a volume of 56.93 cubic feet, reduced to 0° C. (32° F.). The theoretical temperature of combustion of carbonic oxide in pure oxygen would be then—

$$\frac{5{,}603}{3.66 \times 0.22} = 6{,}960° \text{ (12,560° F.)};$$

but the experiments of Deville show that dissociation reduces this amount towards 2,600° to 2,700° C. (4,712° to 4,892° F.). In ordinary air, we have theoretically—

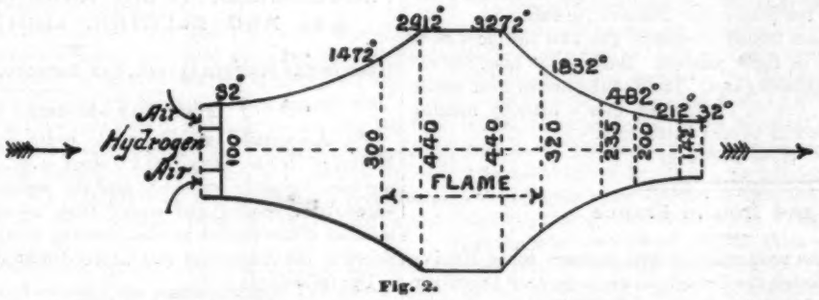

Fig. 2.

$$\frac{5{,}603}{3.66 \times 0.22 + 4.43 \times 0.244} = 2{,}970° \text{ C. } (5{,}378° \text{ F.}).$$

In reality we attain a temperature of from 1,700° to 1,800° (3,092° to 3,272° F.).

It is to be remarked that despite the feeble calorific power of carbonic oxide, it is the substance which produces in air the highest temperatures on account of the low relative weight of its products of combustion. As regards the actual maximum, it is practically the same for hydrogen, carbon or carbonic oxide burnt in air at ordinary pressures.

The experiments of Toost and Hautefeuille seem to show that we actually obtain still higher temperatures by burning in oxygen silicon, whose calorific power is 7,830 heat units, the oxide of which resists dissociation strongly. Twenty-two of silicon combining with 24 of oxygen would produce a temperature of—

$$\frac{7{,}830}{46 \div 24 \times 0.3 \times 2.2} = 13{,}620° \text{ C. } (24{,}548° \text{ F.})$$

In an ordinary furnace the formation of carbonic oxide is immediately followed by the production of carbonic acid; the admission of air is then 150.8 cubic feet per pound of carbon burnt, and the volume of the products of combustion reduced to 0° remains the same, although the first instant it tends to increase by formation of carbonic oxide. The flame begins from the contact of the carbon, which the radiation should keep at a temperature of about 600° C. (1,112° F.) to maintain the combustion. The increase in volume is produced very quickly to reach the temperature of about 1,700° C. (3,092° F.), where it becomes 1,086.77 cubic feet.

The mean diameter of the furnace at its central portion should be then 2.7 times that of the pipe allowing air to enter. The volume of the gases remains fixed, while the loss of heat only compensates the increase due to the combination of the carbonic oxide with the oxygen, then diminishes gradually to the cessation of dissociation, which is at about 1,100° C. (2,012° F.), or where the flame is extinguished. Here there are only waste gases, which still retain $(3.66 \times 0.22 + 8.86 \times 0.244)\ 1{,}000 = 3{,}260$ heat units, a quantity relatively considerable, being some 40 per cent of the total calorific power; and if we utilize the heat to 250° C. (482° F.), we have—

Heat from the flame, 600° to 700° C. (1,112° to 1,292° F.).....	4,816
Heat carried by the gases, 1,100° to 250° C. (2,012° to 482° F.)....	2,523
Heat remaining in waste gases at about 250° C. (482° F.).....	741
	8,080

The volume of the gases at the temperature of 1,100° C. (2,012° F.) is 150.8 (1 + 11.00 × 0.366) = 759 cubic feet, and it is reduced to 150.8 (1 + 2.50 × 0.366) = 289 cubic feet.

At the temperature of 250° C (482° F.) the successive diameters of the openings are then as 2.25 to 1.4, as is shown in the diagram, Fig. 2, serving as a model for shape of furnaces.

By thus neglecting waste gases at about 250° C. (482° F.), we lose 9 per cent. of the total calorific power of the carbon, while in the case of hydrogen we lose more than 23 per cent.

In an apparatus such as a cupola furnace, where all the products of the combustion pass off as carbonic oxide, we utilize only about 30 per cent. of the calorific power.

The escaping gases burnt in their turn in another furnace would produce the missing 70 per cent. These phenomena occur in this way in the gasogenes which furnish gas to an engine or to a special furnace heated by the combustion of carbonic oxide.

We may still utilize in the second furnace a large part of the heat produced in the first one, by causing the gases to pass from one to the other with very little loss of heat; that is to say, by making the gasogene the deep hearth of a furnace, or else with openings leading to it the quantity of air necessary for complete combustion.

We may utilize also the heat contained in the carbonic oxide to heat the air sent to these openings, the same as we use a part of the heat carried by the waste gases in the Siemens or Ponsard furnace.

But in certain cases we are forced to remove the two furnaces or to sufficiently cool the gases in their passage. Such is the case, for example, in motors using producer gases. The definite loss of heat would then be about 30 per cent., but we may lessen this a little by making what is called water gas as will be seen further on.

[To be Continued.]

Coal and Iron in France.

Engineering says that the production of coal appears to be steadily increasing in France, although the French do not take very heartily to coal mining industry. In 1888 the output was 22,602,894 tons. In 1889 the total had expanded to 24,303,509 tons; and in 1890 to 26,083,118 tons. In 1891 there was a decline to 26,024,893 tons; but in 1892 the figures again expanded to 26,178,701 tons. In 1893 there was a decline to 25,650,981 tons; but in 1894 the tide again changed, the output rising to 27,416,905 tons. In 1895 it went to 28,019,894 tons; and in 1896 to 29,310,832 tons. Comparing 1896 with 1888 it will be seen that the output increased to the extent of 6,707,938 tons. Even now French coal mining makes but a poor figure when compared with the development of the corresponding industry in England. This is probably due to the fact that the domestic consumption of coal in France has hitherto been smaller than that of Great Britain, while the development of steam power has been less rapid among the French than upon this side of the Channel. Another reason which has told against a very rapid development of French coal mining is found in the facility with which the French can obtain ample supplies of coal from other countries. They import coal freely from Great Britain, Belgium and Germany; but even after allowing for the supplies thus obtained, the aggregate consumption of coal among our neighbors is much smaller than it is among ourselves. The general tendency of French coal consumption is, however, undoubtedly to increase. Every additional year of peace is, of course, calculated to stimulate French manufacturing industry, while the development of the French navy and the increase of French steam shipping involve a larger demand for black diamonds. Still, having regard to the large coal resources which France undoubtedly possesses, it is somewhat remarkable that the French have hitherto allowed themselves to be outpaced in coal mining by Great Britain and Germany. Even little Belgium nearly keeps step with France in the matter of coal extraction.

The production of pig iron in the Meurthe-et-Moselle last year was 1,455,526 tons, an increase of 201,026 tons as compared with 1895. The production of pig in the Nord last year was 263,989 tons, as compared with 207,685 tons in 1895. The output of the Saône-et-Loire last year was 99,903 tons, as compared with 98,313 tons; that of the Pas-de-Calais, 72,954 tons, as compared with 75,710 tons; that of the Landes, 71,548 tons, as compared with 64,342; and that of the Loire Inférieure, 64,479 tons, as compared with 35,271 tons. It will be seen that with the exception of the Pas-de-Calais all the principal French metallurgical districts produced more pig last year than in 1895. As regards iron, the Nord produced last year 289,532 tons, as compared with 285,076 tons in 1895; the Ardennes, 102,211 tons, as compared with 85,877 tons; the Haute-Marne, 77,468 tons, as compared with 62,405 tons; the Saône-et-Loire, 59,356 tons, as compared with 66,429 tons; and the Meurthe-et-Moselle, 49,073 tons, as compared with 47,748 tons.

It will be seen that the only falling-off in the output last year occurred in the Saône-et-Loire. The production of worked steel in the Nord last year was 176,036 tons, as compared with 136,481 tons in 1895; in the Meurthe-et-Moselle, 120,444 tons, as compared with 98,722 tons; in the Saône-et-Loire, 90,089 tons, as compared with 71,128 tons; in the Loire 69,102 tons, as compared with 60,779 tons; and in the Pas-de-Calais 56,846 tons, as compared with 39,270 tons. These figures only serve to illustrate the outputs of pig, iron, and steel in the principal producing departments. The definitive production of iron in France last year was 814,643 tons, as compared with 756,793 tons in 1895, showing an increase last year of 57,850 tons. The definitive production of steel in France last year was 883,508 tons, as compared with 714,523 tons in 1895, showing an increase of 168,985 tons. It will be seen that while the production of iron increased last year to the extent of about 7 per cent., the corresponding increase in the production of steel was 23 per cent. Upon the whole, 1896 appears to have been a good year for French metallurgical industry.

[Official Report.—Revised by the Secretary.]

PROCEEDINGS, THIRD ANNUAL MEETING, TEXAS GAS AND ELECTRIC LIGHT ASSOCIATION.

Held in the Menger Hotel, San Antonio, Texas, April 19, 20 and 21.

First Day—Morning Session.

The Association was called to order by the President (Mr. T. D. Miller, of Dallas, Texas), at 9 o'clock, A.M., Monday, April 19th. Having been formally welcomed and the welcome having been acknowledged, the President announced that, no objection being offered, the minutes of the second annual meeting would stand approved as published in the American Gas Light Journal.

The following

Report from the Executive Committee

was read:

To the President and Members of the Texas Gas and Electric Light Association: We, your Executive Committee, beg to report:

1st. That we have elected Mr. J. C. Lord to fill the vacancy caused by the election of Mr. Miller to the Presidency.

2d. We have examined the report of the Committee on Revision of Constitution and By-Laws, and recommend that it be adopted as reported herewith.

3d. We have examined the report of the Membership Committee, and approved the applications for membership presented by that committee.

4th. We recommend that the *Electrical World* be discontinued as an official organ of this Association, as it failed to publish the proceedings of the last meeting, and refused to pay part of the costs of the proceedings for this year.

5th. We recommend that the *Electrical Engineer* be voted an official organ of the Association.

6th. We have appointed Messrs. Fuller, Ford and Fitzgerald a Finance Committee. Respectfully submitted,

Thos. D. Miller, President.
F. R. Starr, Jr., Secretary.

After some discussion, the report as a whole was adopted.

The President having granted the Secretary and Treasurer and Finance Committee longer time in which to present their reports, the representatives of the Press were invited to take seats at the table with the Secretary.

Report of Committee on New Members.

The Secretary read the following list of applicants for membership:

Active.

Brown, T. C., San Antonio, Tex.	McGrath, W. H., Dallas, Tex.
Cox, J. R., Galveston, Tex.	O'Beirne, E. J., Gainesville, Tex.
Cushman, G. H., San Antonio, Tex.	Rall, S. A., Chicago, Ills.
Eaton, A. B., Chicago, Ills.	Raggio, V. E., St. Louis, Mo.
Fries, F., San Antonio, Tex.	Stair, O. F., Luling, Tex.
Granger, A., Houston, Tex.	Wells, E. L., Jr., Marshall, Tex.
Green, Eugene, San Marcos, Tex.	Yaeger, C. F., Laredo, Tex.
Leonardt, Emil, Cuero, Tex.	

Associate.

Bradon, E., Jr., San Antonio, Tex.	Murphy, J. C., St. Louis, Mo.
Colvard, R. E., Gordon, Tex.	Peak, H. W., Chicago, Ills.
Hutchings, R. J., Austin, Tex.	Stratton, S. S., Chicago, Ills.
Johnson, J. E., Austin, Tex.	Schuwirth, C., San Antonio, Tex.

The President having announced that all the applications had been approved by the Executive Committee, he appointed Messrs. E. E. Taylor and J. D. Oliger as tellers.

On motion of Mr. Monroe, the Secretary was authorized to cast the ballot of the Association for the election to membership of the gentlemen named; and the tellers subsequently announced their election. The President called to the chair Mr. A. E. Judge, of Tyler, and President Miller read the following

INAUGURAL ADDRESS.

For the third time the fragrance of the Cape Jasmine mingles with that of the Magnolia, and this time, in the atmosphere of the historic old Alamo City, where we will presently witness the "Battle of Flowers," in commemoration of that great victory for freedom, of half a century ago, the battle of San Jacinto.

It is with pleasure I greet you, gentlemen of the Texas Gas and Electric Light Association, and congratulate you on having concluded another year with such success as you have had; for, be it what it may, it might have been not so good, considering that during the past year everything has reached low-water mark, and if recent meteorological conditions are any indications of the future we are entering a high-water epoch of prosperity. At any rate it is safe to say that our copious winter rains will insure good crops in Texas, and good crops mean good times for everybody down here.

Periods of depression are not without their value, for it is in such times that the strictest economies are practiced and valuable experience obtained; higher efficiency is secured where formerly it was not attempted, and stricter and more wholesome policies are adopted.

The most notable event the past year in lighting circles was the Gas Exposition, at Madison Square Garden, New York, opening on the 27th of January, and closing February 6th. It was my pleasure to visit this Exposition, and in my humble way represented this Association *ex officio*, there being no one appointed from the simple fact that no one would agree to go.

It would be difficult indeed to get up an Exposition that would meet with the approval, and receive the commendation, of every one; therefore, you probably have seen and heard some criticism of this exhibition. There is, however, one point of view from which I have heard no one find fault—that is as an Exposition of the various applications to which gas can be put for every purpose requiring light, heat or power, from the conversion of gas into electricity, direct by means of the thermo electric pile, to the gas engine belted to a dynamo furnishing current to the incandescent electric light.

There the ordinary sheet iron heater and the handsomely polished brass dog ironed, abestos back, tiled-hearth heater were on the best of terms, and, in some instances, the former looked down on the latter.

Gas radiators were there in great variety, and a new idea in heating presented in a reflector, by means of which the heat is reflected from a gas burner in any direction to any portion of a room, the reflector being placed five or six feet from the floor. This device impressed me as being homely and cumbersome, but it may in time be brought to the point of a joy forever.

The instantaneous water heater was there in great variety, handsome in style and beautiful in finish, and should, as it did, excite a great deal of interest.

Then, as the outgrowth of the demand in recent years for pure water, was an automatic water still, furnishing chemically pure water for all purposes. To my mind this opens a new field for the use of gas in a convenient form and economic manner.

The Welsbach light was there in force. The whole display was in fact a triumph for this light, of which there were 6,000 lamps in the Garden. From the great variety of decorations shown, it would be safe to say that the most fastidious could have found just what would suit him in trimmings for a Welsbach. Then there were several devices for adapting this lamp to street lighting, which are in use in many cities in the East, and are giving eminent satisfaction.

Gas stoves were also there, and in extent of display were second only to the Welsbach lights. New ideas in old dress and old ideas in new dress. Stoves with upright broilers, combination broilers and bakers, water backs attached and detached, all handsome in design and elegant in finish, and, it was intimated, cheaper than ever.

There was a coal mine exhibited in operation. Apparatus for converting the coal into gas, and so on through each process in its manufacture, distribution and sale—in fact, all sorts of apparatus for testing any and everything connected with the manufacture and sale of gas.

Water gas apparatus was there also; a complete plant, 5 feet set, full size, being shown. In fact, it would have been the easiest thing in the world to have bought a complete gas plant, coal gas, water gas or Pintsch gas, at Madison Square Garden for about a week.

One thing was especially noticeable for its absence; that was acetylene. However, an acetylene burner was exhibited.

The gas tower was very handsome and ingenious, and would have been much more admired had its lights, which were mostly common tips, not been dimmed by the extreme brilliancy of the Welsbach lights.

It is a pity that greater prominence was not given to the bye-products of the gas works, for the general public have very little idea of the great number of comforts, conveniences, luxuries and actual blessings to mankind that are in daily use which come from the bye-products of the gas works.

The past year has witnessed several serious casualties in the exploitation of acetylene, and while the experience has cost many lives and much property, it apparently has established the fact that liquefied acetylene is liable to decompose, thereby increasing the pressure on its container to an amount not yet ascertained, as it has thus far exploded with fatal results. This decomposition, however, does not occur at a pressure no greater than that of the atmosphere. It is also well established that its explosive powers are far greater than those of coal gas or carbureted water gas, and that its explosive powers begin at a very much poorer mixture and extend up to a very much richer mixture than ordinary gas.

To compete with ordinary gas at $1.25 per 1,000 cubic feet, calcium carbide would have to be furnished to gas companies at $40 per ton, if the ordinary gas be used with the ordinary burner; and to compete with the $1.25 gas used with the Welsbach burner the calcium carbide would have to be furnished at about $20 per ton. This is purely theoretical, but considered from a practical standpoint there is a great deal more to it. Suppose a plant sending out 100,000,000 feet per annum, with a leakage of 10,000,000, were to begin sending out acetylene gas. To supply the same amount of light the sales of acetylene gas would be about $\frac{1}{10}$ that of the ordinary gas. Therefore, while with the ordinary gas the sales were 90,000,000, the sales of the acetylene would only be 9,000,000, but with the same system of pipe the leakage would be the same; consequently to sell the 9,000,000 feet 19,000,000 would have to be sent out, making the leakage account over 52 per cent, instead of 10 per cent., as formerly. It does not require much more calculation to convince one that the cost of calcium carbide must be very much less than $40 per ton to be used in competition with $1.25 coal gas, or a very much more perfect system of distribution must be devised. It has also been shown that the electrical energy used in making calcium carbide would produce more light if stored in a storage battery and used at will than would the acetylene from the calcium carbide.

As a lighting agent acetylene will have its field, but it is not probable that it will come into general use for such purpose.

It would give me great pleasure to conclude these remarks with something of technical interest to our electrical brothers, but on electrical matters I am more of a question mark than an exclamation point.

Our Association is to be congratulated on this its third annual meeting, with such encouraging surroundings and zealous enthusiasm of its members, and I thank you for your kindly effort to make it so.

Upon motion of Mr. Monroe, of Dallas, the address was approved, accepted and ordered published, and the Association extended its hearty thanks to the author by a unanimous vote.

On call of the Chair for the report of the Executive Committee on the Constitution and By-Laws, which draft, after discussion, it having been read section by section, was held over for adoption. The final action taken appears further along in this report.

The President then introduced Mr. J. C. Lord, of Fort Worth, Texas, who read the following paper on

A MEANS OF LARGELY INCREASING THE SUMMER SENDOUT OF GAS.

Mr. President and Gentlemen of the Association: In presenting this paper on a subject of so much interest to all gas companies, I had hoped to prepare an article which might bring out this question's point of interest with all elaborateness of detail; but, much to my dismay, I find that at all late meetings of Associations preceding this one the question has already been so ably and thoroughly discussed, also in each succeeding numbers of the GAS JOURNALS; and, to my elaborately planned paper, I find "disaster follows fast, and follows faster," until I can only

cry with the unhappy Moor, "Othello's occupation's gone," so I am left chewing the fag end of a fond regret. Therefore, I am convinced that a lengthy or minute rehashing of points could only prove very tiresome and a great bore, so I concluded to confine myself to my own experience, which at least will have the merit of briefness, and, in the advertising language of the story publishing periodicals of the period, has never been in print before. Every time I would secure a regular clincher and would begin to investigate its past record I would find that other managers in other States and of other Associations had used the same ideas in their own business, and were willing to tell all about it, until I found that the past histories of gas stoves had been very thoroughly investigated, and their usefulness proclaimed as it were from the rostrum, through the press and in the highways and by-ways.

It is not necessary for me to take up your time in discussing the superiority of a gas range over either coal or wood stoves—I only do that to my consumers—for this is already conceded.

Our plan of action was as follows: In the spring of '94 we concluded that a personal house-to-house canvass was the best means to come in close contact with the public. Various objections were raised against the use of gas for cooking purposes, principally on account of its cost. To overcome this our Company reduced the price of gas, for fuel purposes through separate meters, from $2 to $1.75 per 1,000 feet, and, up to December 31, we had sold 160 stoves. Our fuel consumption, from March 1 to December 31, was 5,117,500 cubic feet, with an average per month per stove of 2,613 cubic feet. In 1895, believing that a further reduction would still increase the output, we reduced the price to $1.50 per 1,000 cubic feet. In the year ending December, 1895, our fuel sales were 5,316,600 feet—an increase of 5½ per cent.; number of consumers, 209; average per consumer per month, 2,134 cubic feet.

Up to the years 1894-5 the sale of stoves was confined to a territory embracing what might be termed the well-to-do people. Up to this time objections were made that gas at $1.50 per 1,000 cubic feet was not as cheap as either wood or coal. Complaints of this character came from people who left the entire culinary management to the colored cooks, who, of course, had no interest in paying the gas bills. During the early spring of 1896 we made a personal canvass among a class of people who live in rental property, where, of necessity, economy is practiced. We found a great many people who were willing to use gas stoves, but who were unwilling to run service pipes for the landlords. To meet this class of consumers, on April 10, 1896, our Company made a still further reduction, to $1.33⅓ per 1,000 cubic feet, and agreed to run service pipe from main to meter free of charge to all parties who purchased a gas stove. Such sales were made on the installment plan. A great many were put in on 30 days' trial, with an understanding that if they were not satisfied the stove could be returned, they paying for the gas consumed in that month; and in the course of last season's business, with a sale of 218 stoves, but two were returned. The success of this last venture was fully proven by the sale of 7,950,000 cubic feet of gas for the year ending December 1, 1896, being an increase of 33 per cent. over 1895; the number of fuel consumers, 427 (a gain of 218 in one year); average per consumer per month, 1,862 cubic feet.

To be sure, we have not been able to find any plan, that has not already been tried, to more satisfactorily increase our sales. Various methods have been adopted by us with a view of establishing some definite plan toward introducing gas stoves; but from the experience gathered from some of the larger companies it is evident that the person in charge of this branch of the business must adopt some plan to suit the conditions as they exist in different localities.

I trust that the discussion may throw some further light upon this important subject that will result in profit to gas companies and be more satisfactory to the public in general.

Discussion.

The President—I will start the discussion by asking, How did Mr. Lord ascertain the sales? By actual meter readings?

Mr. Lord—By actual meter readings monthly. We have separate meters, and both appear. The one supplying the stove is marked "fuel."

Mr. Holmes—The most important thing in this paper is the price of gas. It seems to me that gas at $1.33 is cheaper than we can afford to make and sell it as a rule in Texas, even for fuel purposes; and while he has gained a large number of consumers, it seems to me the price of gas is too low. I would like to ask him what the candle power was.

Mr. Lord—From 16½ to 18; straight coal gas.

Mr. Holmes—Then, too, he tells us he runs a service pipe free, and runs into rented property. Do you find that that pipe is used right along all the time; or do they use it for a month, or a few months, or a year, and then discontinue the stove. Suppose new parties move in, does your service lie idle for some time?

Mr. Lord—That is the point I wanted brought out. We meet with the greatest success with the people who live in rented property. Where the conditions are alike, people with servants will burn, say, 2,500 to 3,000 cubic feet of gas per month, but where the people do their own work they will use 1,500 or 2,000 cubic feet of gas. We have some consumers who use it the year round, because they say it is cheaper than coal or wood.

Mr. Holmes—I think Mr. Lord's success has been very gratifying, and I was glad to hear him say what he said about free service pipes. We, at Austin, have lately been taking up that question. Our custom has been to run the pipe in the street at our expense; but to run the pipe on the consumers' property up to the meter at their expense, or up to the stove at the expense of the consumer, charging a price that covers about the cost of it. We do not make anything on it, but it is a question with us whether it is advisable for us to do as Mr. Lord says he has done—run the service pipe free. I would like to ask if he makes a charge for the meter, or does he render minimum bills?

Mr. Lord—We put them in free; we make no charge for the meter, and render no minimum bills.

Mr. Holmes—Do you find that the consumer saves anything?

Mr. Lord—The bills never run short of say 1,000 feet per month—the minimum would be about 1,000 or 1,500 feet per month. Of course it is the low price of gas that brings us that class of customers. They can't be reached in any other way—only by a free service. They are the best customers we get.

Mr. Holmes—And they do all their work on the gas stove?

Mr. Lord—Yes, sir.

Mr. Holmes—And you have about 500 stoves?

Mr. Lord—427. In the sales of these stoves for '96 there were about 25 heating stoves; but as all came under the head of fuel gas we make no distinction.

The President—That included the Backus heater consumption and all other consumption through the fuel meters?

Mr. Lord—Yes, sir; it all comes under that head.

Mr. Holmes—You have placed over 400 stoves or more within the past three years?

Mr. Lord—No; during the year 1894 there were some gas stoves in use in Fort Worth, but as our gas was $2 per 1,000 we could not compete with wood. People would use the gas stove two or three months in the very warm weather, but would not use them continuously. We might have had 25 or 30 gas stoves eight years ago when I went there, but the great gain came when we reduced the price.

Mr. Holmes—Asking further about the methods: You say you made a house-to-house canvass. Did you also advertise in the newspapers?

Mr. Lord—We advertised in the newspapers to a great extent, and the people would come into the office and look at the stoves we had on exhibition; but the greatest success we had was in making the personal canvass and in talking stove to them. We asked them to let us put in a stove on 30 days' trial, at the end of which time, if they did not care to continue with it, they could return it, paying of course the cost of the gas that had been used in the month. In the meantime we instructed the cooks in the use of the stoves, or perhaps a greater number would have been returned to us. A man who uses $10 worth of gas and comes in and finally pays his bill, and kicks about it, is a good customer; but the man who pays us $2.50 to $3 is our best customer. The stoves are giving the best of satisfaction. Last month a party who had just moved into Fort Worth bought a gas stove. He wanted to know what the cost of gas would be, but we wouldn't give him any guaranty. We put in the stove on trial and at the end of the month the bill was $9. That stove was taken out. But that was not included in that report, as the paper was written before that time. The man's wife did the cooking, and how she ever burned $9 worth of gas I can't understand; she must have kept it burning nearly all the time, as many of them do. For instance, with the boiling flame: In making soup they turn the burner on full and bring the soup to a boil, and while they can't do anything more than boil it, they don't turn the flame off—they burn the gas right on. Those things are all injurious to the use of the stove; but at $1.33 we can compete with coal or wood.

Mr. Holmes—You say you sell the stoves on the installment plan? Do you sell them at practical cost plus the freight, or do you make a profit on them?

Mr. Lord—We sell them at actual manufacturers' charge, with freight added, and charge 50 cents on each stove for drayage. We bear the loss consequent in running the service, but the increase in the con-

sumption pays us in the end, we think. The consumption is a good deal larger.

Mr. Holmes—Mr. Lord's experience is very gratifying indeed, and I think that paper alone has been worth as much to me as the entire cost that the Association has been to me since I have been connected with it; and I am one of its charter members. (Loud applause.)

Mr. McGoldrick—Our gas rate at San Antonio is almost as cheap as the rate at Fort Worth, figuring what we pay for coal here. If our consumers bought coal or wood, our gas, I think, would be almost as cheap to them. We haven't followed Mr. Lord's idea in selling stoves and running service, pipes, etc. I would like to ask Mr. Lord what coal costs in Fort Worth?

Mr. Lord—Our coal (Macalester) costs us $4, freight added—about $4.10 laid in yard.

Mr. McGoldrick—You spoke about a consumer using $9 worth of gas. Did he have a water heater attached to heat his kitchen boiler?

Mr. Lord—We don't use the water backs. There is nothing else that will give a person as much for his money as one of these Douglas heaters. One can take 60 baths a month for 90 cents.

Mr. Judge—I think Mr. Lord's position on that question is correct. The increase on the cost of his fuel, on wear and tear on his plant and interest on his capital are much less than the increase in the receipts. The result is, taking that business, largely done during the hours that the gas is not used for lighting, he increases the net profits of his concern by business that he could get in no other way. I think it a most excellent paper.

Mr. Holmes—In reply to Mr. Judge, I will state, as I said before, I think his position is correct in a measure, but I think Mr. Lord is too low in his price for gas. If his send-out were large enough at that price it would be all right; but as it is it seems to me he is selling his gas too cheap. Mr. Judge's position is correct in a measure, at least; but you can't make your lighting business bear all the expenses, with the exception of the coal, fuel, labor and all that sort of thing. It seems to me he is getting it a little too low for the amount of business that can be done in a city the size of Fort Worth. If they had 100,000 or 200,000 inhabitants the matter would be different; but in a city of that size it seems to me that $1.33 for 18-candle gas is cheaper than it really ought to be in justice to yourself and your stockholders. I would like to hear from Mr. Fitzgerald on that.

Mr. Fitzgerald—I think Mr. Lord's position is right, if he finds that it produces revenue sufficient to justify him for making the change. I think a man supplying gas ought to supply the people with the product just as cheaply as he can. Mr. Lord's position is right, if his increased revenue from the sale of this cheap gas will pay him a reasonable per cent. on his capital. There cannot be any question about that.

Mr. Cox—Mr. Lord told us the number of cubic feet of gas he puts out in the year. Is there an electric man here who can tell me how many watts he produces to the pound of coal, or how many watts he produces in a year?

Mr. Cushman—We can give you that information.

Mr. Cox—Can you give that information as to the cost of coal—or as to the number of watts produced by a pound of coal?

Mr. Cushman—Yes, sir.

Mr. Cox—They have reduced the gas rates in our town to $1.50. I have very little information to give you about gas, but they have followed out the same principle that Mr. Lord has. They advertise extensively in the newspapers, and are offering gas stoves at actual cost, plus freight and drayage. The information obtainable at the end of the first month's run enabled the Superintendent to say to me that the results are very gratifying. Evidently they are somewhat in line, although they haven't got the gas rate down to $1.33. I presume gas in Galveston would cost a little more on account of a certain amount of repairs which are due to the salt corroding the piping, I suppose, somewhat, and by electrolytic action. The whole soil and atmosphere are pregnant with salt, and the pipes rot and get foul, and there are leakages that would not be met with in other places in the State. I would only be too pleased to give any information that I could, but I haven't been in Texas long enough to obtain much information in regard to the actual cost, for it takes a long time to acquire that by actual methods. The gas men have the best of us there; they can tell intelligently by the meter what they are doing. The electric light man cannot do that.

Mr. Lord—We find the actual cost of gas printed in the public papers. Sometimes a man will come along and offer to make gas and produce it at 50 cents, or 25, or even 10; but those things you know are not facts. Different conditions in different localities cut a great figure.

Mr. Cox—It would be a very nice thing to know what the actual cost is of the different items. The cost of producing so many watts to the pound of coal is one thing; the actual cost of that electricity is a different thing. While I am not sufficiently acquainted with the gas business to make the analogy, yet I think something of that kind is wha we want.

The President—You mean the cost of the gas in the holder compare with the electricity at the plant.

Mr. Lord—Mr. Holmes said we ought not make the lighting busines bear all the expense. I happen to be in the electric lighting business and we are furnishing the incandescent lights at 50 cents a month and arc lights at $5 a month, night and day; that shows the competition

Mr. Cox—Are you making any money on that?

Mr. Lord—No, sir.

Mr. Cox—Are you losing any?

Mr. Lord—Yes, sir.

Mr. Cox—I believe I have a little information. They have introduced a calcium carbide plant in Galveston, and I was called in there some time ago for the purpose of making an efficiency test—I don't believe I am violating any confidence in giving you that information. The mill is a very simple thing as it is operated. It consists in nothing more than the ordinary arc light, run from a 10-ampere circuit; there are the two ordinary carbons one above the other, and a mixture of coke and lime; the two are fused together and they manage to get a little calcium carbide. After that they started in with a rotary machine for the purpose of carrying the compound mixture under the arc. This time the carbons were increased from the ordinary ¼ inch up to one of 1 inch in diameter for the bottom carbon. The holder for the mixture was made to serve duty as the negative carbon. The gentleman down there has a patent on a flux, which consists of nothing more or less than common washing soda. They mix up the washing soda with the coke and lime, and it most certainly did reduce the time of the production of the carbide. The actual voltage crossing the mixture is about 100, and with an amperage of 150 you will produce a piece of carbide, weighing about a pound, in from 10 to 15 minutes. Seven and four-tenths cubic feet of acetylene gas was made and pushed through the meter as fast as we could generate it. The result of our experiments in the carbide that we produced that afternoon cost us for electrical energy in the neighborhood of 33,000 watt hours. I would like an opportunity of correcting these figures at some future time—I didn't bring the exact figures with me, but it was about that much. The carbide went very nearly 5 cubic feet of acetylene gas to the pound. By taking the resulting carbide and putting it into any vertical vessel suitably covered, and putting in the full weight of water, the gas burns with very great brilliancy, and I would say it would be a very great competitor of even electric light. That is the result they got down there; but taking a comparison of prices which I worked out for them I found that the cost as compared with Galveston gas was very nearly the same. That is, figuring it out from resultant gas, not the carbide, it was so very close to it as to reflect the prospects of having very much of a competitor.

The President—You figured the actual cost of the acetylene gas against the selling price of the coal gas.

Mr. Cox—Yes; I had no profit on the acetylene gas.

Mr. Lord—I am glad to see the electric light men taking so much interest in the gas question. I would like to hear more discussion on this. If any of you electric light people live in a town where there is gas try a gas stove. (Laughter.)

Mr. Judge—In reply to Mr. Holmes remark that the lighting business should not be made to bear the whole of the expense, interest on the capital—

Mr. Holmes—And office expense.

Mr. Judge—I don't see why it should not be, if the stove business could not be gotten in any other way; and the increase of the revenue were enough greater than the expenses to pay for the additional attention. Not having the full business, you have to bear those expenses and burdens any way, and if in addition to that you can get business that you can get in no other way that will increase your net profit—that is what you are after. It seems to me Mr. Lord's position is correct, that he has a line of business that he could get in no other way, which is no burden in carrying the interest on his capital, it does not increase the interest on his capital, and he doesn't have to increase the expense of management. It is merely a question of increased receipts and expenditures, and the increased expenditures are in no way bearing the same proportion to the increased revenue that it does on the other hand. Of course, if he had entirely a fuel plant, or if he could get that business as regularly as he can the lighting, it might be all right to insist on dividing the expense for interest and management between the two, but I think Mr. Lord is correct in that.

Mr. Holmes—In reply would like to say that position is correct, only he has gone too far. Now, if it is good to cut from $1.75 to $1.50, and from $1.50 to 1.33⅓, why not make it say $1, 90 cents, 50 cents, 25 cents. The only point I wanted to make is that he has gone too far. He is selling his gas for less than he is justified in doing with the send-out he has.

The President—I would like to remind Mr. Holmes that in the cost of gas these items enter: Cost of coal, labor, distribution, maintenance of works, and the distributing system of pipes. Now, in the gas business it is the same as the electric business, but not so much so; the bulk of the business is done in a very few hours at night. A plant can be prepared to supply its lighting business, and at the same time furnish practically just as much gas to be consumed through the day without any additional labor, without any additional expense, excepting perhaps one more collector, or one more man in the office to look after the business, and the cost of the coal to make the gas; therefore, he increases the quantities of the sale without increasing but one or two items of the cost, every other item of the cost continuing the same. Of course, there is a point at which that would cease, but until you have reached that point you can consider that the increased cost of gas for day consumption is only as to those two items.

Mr. Lord—The increased cost of coal only affects one item—the item of raw material. There has been no change in the collection or office force in the last seven years. We get that increased send-out by putting the price down.

Mr. Monroe—Can anyone tell us what is the cost of gas at the meter?

Mr. Lord—If Mr. Cox will come to Fort Worth, I will give him some pointers on the cost of gas.

The President—I can tell you the cost of gas in the holder for five years back.

On motion of Mr. Fuller, the Association extended a unanimous vote of thanks to Mr. Lord for his excellent paper.

(To be Continued.)

Anhydrous Ammonia for Ice Machines.

Mr. Henry Faurot, in a paper on the subject named in the heading, read before the Southern Ice Exchange, says:

Ammonia, under ordinary conditions, is a colorless gas, consisting of a combination, or union, of two other gases, nitrogen and hydrogen, in the proportion of one part of nitrogen to three parts of hydrogen by measure. Under ordinary conditions of temperature and atmospheric pressure, as stated, it is a gas; yet at a temperature of 40° below zero, at normal atmospheric pressure, or when it is subjected to 100 pounds pressure per square inch at ordinary temperature, it becomes liquid; while at about 110° below zero it congeals or freezes to a white, crystalline, odorless mass, becoming chemically inert and not showing any of the affinities or characteristics which belong to it while in a liquid or gaseous state. The boiling point of liquid ammonia varies with different observers all the way from 40° to 30° below zero F.

Ammonia gas, when pure, is not combustible; it burns only when mixed with air or oxygen, and then with explosive force. It is said that ammonia decomposes slowly when subjected to a heat of about 212° F.; faster at a higher temperature, and at about 800° F., it rapidly and almost instantly separates into its component gases of nitrogen and hydrogen.

Ammonia gas is readily soluble in water, 1 volume of water dissolving at 32° F. about 1,148 times its volume of ammonia gas, and at an ordinary temperature about 730 times its volume.

In the operation of ice and refrigerating machinery, the quality of the anhydrous ammonia used is of great importance, and the best results are attainable only when pure ammonia is used. To buy as cheaply as possible is good business sagacity when quality has its proper share of consideration, but poor ammonia, whatever the price, is the most costly article about an ice or refrigerating plant. If, in purchasing a cheap or low grade ammonia, one were to lose only the percentage of impurity it might contain, the hardship would not be serious.

To illustrate: Suppose one buys a barrel of oil containing 3 per cent. of water. Here 97 per cent. of pure oil would have full value, the only loss the buyer sustains being the price paid for 3 per cent. of valueless substance. This cannot apply to liquid ammonia, for the mere presence of a small percentage of impurity is not only a loss in itself, but by its presence affects and depreciates the working value of the bulk of pure ammonia, rendering the whole of lower grade.

It is a well-known law in chemistry that most liquids, when chemically pure, have a fixed boiling point. The addition of any substance or impurity raises or lowers this boiling point, and in liquid anhydrous ammonia it raises it, which means that ammonia boils, or "expands," at a higher temperature; and, as the purpose of a refrigerating or an ice making plant is the low temperatures, or "cold," produced by evaporation, boiling or expansion of the liquid ammonia in the expansion of brine tank pipes, it is evident that the best or cheapest ammonia, in the end, is that which boils or expands at the lowest temperature; in other words, the purest.

This refrigerating effect is not the only one to be considered, as the purer the ammonia, the less power it takes to compress it to a liquid, and power in this case means a good deal of money expended. It means the cost of operating the engine and boiler rooms, the cost of coal, water, oil, machinery, wages and other items.

Another and most important source of loss caused by the use of impure ammonia is the greater liability to disintegration than that of the pure; for, as everybody knows, impure substances are more likely to decay or spoil than those that are pure. This applies even to substances at rest, while in the cycle of operation in a refrigerating plant, the ammonia is continually undergoing the most extreme conditions of heat and cold, compression and expansion, and a probable electrical excitement through friction of machinery, etc.; all of which are aids in hastening any predisposed tendency to disintegration.

The substances usually making up the impurities in anhydrous ammonia are foreign gases, oils, water, mineral matter and salts of ammonia. Foreign gases consist partly of air, due to defective packing of the piston rod of the compressor, but mainly of methane (commonly called marsh gas), ethene, acetylene, carbon monoxide, carbon dioxide, propylene, vapors of benzol, toluol and ethane, sulphureted hydrogen, etc., some of them being inflammable and explosive.

When these gases find their way into a refrigerating system, owing to the much higher condenser pressure necessary for their liquefaction than is required to condense pure ammonia gas, they greatly increase the power necessary for proper compression. Furthermore, methane and other inflammable gases, by the high heat of compression which they cause, readily decompose, and in so doing greatly assist the decomposition of the otherwise staple ammonia; and should there be any air or oxygen in the system, would possibly cause the violent explosions which happen now and then, and for which no positive explanation has as yet been agreed upon. However, I am of the opinion that the above-named gases are not infrequently the cause of these explosions. All these decomposed and foreign gases are commonly known as "air" or "foul gases," and an idea may be easily formed of the enormous loss of power due to their presence from the fact that decomposed ammonia—that is, nitrogen and hydrogen—furnishes only about 8.7 per cent. of the refrigerating effect that pure ammonia furnishes. In other words, they require over eleven times more power to produce a given refrigerating effect than they do when combined as ammonia.

Upon evaporating impure liquid ammonia, a pale yellowish fluid remains behind, which is generally called the "water" of ammonia. This consists partly of heavy mineral oil, which is detrimental, as it works its way into the expansion pipes, forming a non-conducting coating on the inside; and also consists principally of some of the different varieties of alcohol—methyl, ethyl, propyl, etc.—and other liquid compounds, all of which are highly inflammable and decompose easily.

Other impurities are water, mineral matter and salts of ammonia, which quite often attack the working parts of the machinery or clog the valves of the system.

The pipes and system in which ammonia is used should be thoroughly clean, as pure ammonia in a dirty system will work as badly as impure ammonia in a clean one. Ammonia should be tested not only for the protection of the buyer, but for the protection of the seller as well. There are many devices for testing anhydrous ammonia, but it is my purpose to submit only a few easy and convenient methods that any engineer can employ, and while they are not calculated to demonstrate with the nicety of an exhaustive laboratory analysis, they will answer all practical purposes. To determine liquid residues I use a glass tube about 6½ inches deep and 1½ inches in diameter, and drawn out to a narrow tube at the bottom. The capacity of this tube is 100 cubic centimeters, and the narrow bottom is divided or graduated into cubic centimeters and fractions thereof. The top is supplied with a rubber cork having a vent tube of glass, the outer portion of the vent tube being bent down close to the large tube in such a manner that the whole may be placed in a glass of water. To convey ammonia

Ammonia Test Tube.

from the cylinder into the tube a short iron pipe should be screwed into the cylinder valve. Open the valve and allow enough ammonia to run out to thoroughly cleanse the valve and pipe of any rust or other impurities that may have accumulated in them. Then let the ammonia flow into the tube until it is half full; adjust the cork and set the large tube into a glass of water, placing another glass of water beside the first to receive the vent tube. As the ammonia boils, the gas passes off through the vent tube and is absorbed by the water in the glass.

Care must be exercised to remove the vent tube from the water toward the end of the operation, and allow the last part of the ammonia to evaporate into the air, otherwise the water will be sucked into the tube and thereby spoil the test. The residue, if any remains, can be easily read through the graduated scale. If a quicker evaporation is desired, it can be obtained by placing both tubes in one glass of water. The test tube should be carefully cleaned, and wiped perfectly dry before using.

To test for inflammable gases, have the iron pipe bent in such a manner that the ammonia can be discharged into the bottom of a pail of cold water. Submerge over the mouth of the pipe a glass funnel, having the end tightly corked. Allow the ammonia to flow in a small stream. The ammonia gas will be absorbed by the water, while the other gases will rise to the top of the funnel, and if methane or other inflammable gases are present, they will, if released and lighted with a match, burn with a blue flame.

To test for boiling point, draw off about 6 to 8 ounces of liquid ammonia into a cylindrical shaped glass or chemical beaker. Place this on a wet iron plate or surround it with water, and when it boils insert into it the bulb only of a special low standard chemical thermometer, reading off through the walls of the glass, and observing the temperature when the mercury remains stationary, as the boiling point. Commercially pure liquid ammonia should boil at not higher than 28.6° below zero F.; lower temperatures denote purer ammonia, while a less pure ammonia boils at a higher temperature. In testing for the boiling point, the thermometer should be held as stationary as possible, and not moved about in the liquid.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. T. G. Littlehales has been appointed Superintendent of the Pittsburgh Gas and Coke Company's works, at Glassport, Pa.

The proprietors of the Derby Gas Company, of Birmingham, Conn., have ordered a reduction in the net gas rate of 20 cents per 1,000 cubic feet—from $1.60 to $1.40. The concession became operative on the 1st inst.

At the annual meeting of the Columbus (O.) Gas Company the following Directors were re-elected: Emerson McMillin, W. H. Doane, C. D. Firestone, D. E. Putnam, N. B. Abbott, P. H. Bruck, R. C. Hubbard, James Watson and Irvin Butterworth. A dividend of 3 per cent. was also declared, payable on and after the 20th inst.

The net prices established by the Council of Iowa City, Ia., for gas supplied by the Iowa City Gas Light Company, are: For an illuminating use, $2 per 1,000 cubic feet; for a fuel use, $1.50 per 1,000.

Mr. Ross, the Secretary of the Laclede Gas Light Company, of St. Louis, Mo., has notified the residents of St. Louis that, for the month of May, the Company will make service connections free to all consumers who desire to use gas for fuel purposes; the agreement, however, further provides that the houses of such applicants must be within 25 feet of the building line.

A correspondent forwards the following: "The annual meeting of the stockholders of the Wilmington (N. C.) Gas Light Company was held pursuant to notice. Organization was effected by the election of Colonel J. W. Atkinson as Chairman. Mr. Donald MacRae was chosen Secretary. The minutes of the last meeting having been read and approved, the President of the Company (Mr. Eugene Martin) made a verbal report on the affairs of the Company, after which the annual reports of the Secretary and Treasurer (Mr. R. J. Jones) were read and approved. The President's statement and the reports by Mr. Jones showed the Company was in prosperous condition. The election for Directors resulted as follows: A. J. De Rosset, J. F. Divine, Geo. R. French, Geo. W. Kidder, Donald MacRae, G. H. Smith and E. S. Martin. Immediately following the election of Directors, the latter perfected the following executive organization: President, E. S. Martin; Secretary and Treasurer, R. J. Jones; Superintendent, John W. Reilly."

The proprietors of the Baraboo (Wis.) Gas and Electric Light Company hope to have their electric lighting annex (it is arranged for the supplying of both arc and incandescent lamps) in working order by June 1st.

The proprietors of the Gas Light Company, of the City of New Brunswick, N. J., have ordered a reduction of 20 cents per 1,000 cubic feet in the selling rate—from $2 to $1.80 per 1,000. The concession is to apply from the 1st inst.

The 13th annual report of the Directors of the Philadelphia (natural gas) Company, for the year ended March 31, shows assets and liabilities of $9,419,822.28 The chief items of assets are, accounts receivable, $281,557.52; stock, Allegheny Heating and other Companies, $386,470; gas wells, $483,065; pipe lines, $5,697,169.12; charters, franchises, patents, etc., $521,944.30; regulators and meters, $615,977.50. The bills payable amount to $399,714 72, and the profit and loss account shows $1,322,988.33. The earnings of the Company were $1,289,845.99. The operating expenses were $789,297.79, and $243,798.91 were charged to expenses, which amount represented expenditures on account of extension of pipe lines. The surplus for the year to profit and loss was $256,749.29. During the year 52 wells were drilled, of which 31 were productive of gas, 11 of oil, and 10 were non-productive. The results of drilling operations for four years show a gradual reduction in the percentage of non-productive wells, from 30.5 per cent. in 1894 to 19.2 per cent. in 1897. Five wells were purchased, one of which was in Tyler County, West Va. In the 12 months, 32.32 miles of pipe were reclaimed, and 54.58 miles were laid. The total length of pipe lines now operated by the Company is 924.41 miles, connected by 380.3 miles of telephone lines. The Company has under lease 88,704 acres of gas and oil territory, situated in 8 counties of Pennsylvania, and 2 in West Virginia. The rental and royalties paid for this territory last year were $90,206.52. The bills payable of the Company were reduced from $689,089.26 to $399,714.72, and since the close of the last fiscal year the debt was still further reduced by $75,008.54. The entire output of the Company is now sold by meter, and the output disposed of for the year ending March 31, 1897, was 10,857,956,000 cubic feet.

On the last day of April the House branch of the Massachusetts Legislature considered the bill, in order for third reading, proposing to incorporate the Commonwealth Gas Company—for mention of the purpuposes of which, see Journal, March 8, 1897, p. 370. After some debate the House declined to send the bill to third reading, the vote standing 78 against to 37 for progressing the measure.

Mr. Arthur G. Glasgow, of Messrs. Humphreys & Glasgow, of New York, arrived home, from England, per steamship St. Paul, on the 1st inst. He was quite glad to reach New York, even though the day was rainy.

We have had an occasional line from Mr. C. M. Higgins, who, despite the ease and delights of European travel, rather seems inclined to view his return to the land of tariffs and freedom in the light of coming from good to better. It is likely that he will be in Cincinnati next week at the meeting of the Western Association, and, no doubt, he should and will consider himself a fair subject for inquiry in the matter of the Western's "Experience Recitals."

Mr. Frederick Egner, writing to the Journal from Vienna, under date of April 22d, says that the Vienna authorities are erecting a municipal gas plant in that city, the carbonizing department of which is to consist of 180 benches (all nines) of retorts on the "sloper" principle. The work of construction is being directed by Herr Herman. This construction is the result of a difference between the Vienna authorities and the proprietors of the Imperial Continental Gas Association (who have been supplying gas to Vienna for a term of years) over a conference respecting the renewal of the Imperial charter, which expires in 1901. The conferrers could not agree on terms, and the Viennese authorities determined to engage in the supply on public account, and for ordinary account also. The municipal plant is located not far from the Erdberg station of the Imperial Continental Association in Vienna, and it is arranged on the basis of a maximum daily make of 22,000,000 cubic feet.

Mr. John Morton has purchased the plant and franchises of the San Mateo (Cal.) Gas Company, and will improve the properties—they

need improvement too. Mr. J. Wiesender, the former proprietor, will keep on managing the Company's affairs.

Messrs. I. P. Raup, Kimber C. Raup, Edward B. Raup, William Frederick and William R. Peoples, of Jersey Shore, Pa., have applied to the authorities for the right to operate a gas works at that point. Jersey Shore is in Lycoming county, Pa., at a point on the west branch of the Susquehanna river, two miles north of the Philadelphia and Erie Railroad, and is about midway of Williamsport and Lock Haven. It is quite a flourishing settlement, but in our opinion it is far too small to support a gas works.

At the annual meeting of the United Gas Improvement Company the following officers were elected: Directors, Thomas Dolan, George Pailler, Wm. L. Elkins, P. A. B. Widener, C. A. Griscom, W. W. Gibbs and Samuel T. Bodine; President, Thomas Dolan.

Mr. J. H. Maxon, Superintendent of the Gallipolis (Ohio) Gas and Coke Company, writing to us under date of the 28th ult., says that President Stockhoff and his associates have authorized him to announce the fact that all gas used in Gallipolis, beginning with the 1st inst., will be billed at $1 per 1,000 cubic feet. The prior rates at Gallipolis were: $1.50 per 1,000 on fuel account; on illuminating account, $2. When the illuminating account per month exceeded $4, a discount of 10 per cent. per 1,000 was allowed, which discount was increased to 25 per cent. when the account per month exceeded $10. The new rate is a surprisingly liberal one; but it undoubtedly means that the Gallipolis Gas Company will no longer be satisfied with aping the position for so many years occupied by its quasi-namesake on the Gulf of Taranto. To make the reference plain, the proprietors of the Gallipolis Gas and Coke Company propose to free themselves from any interference with their property by the local electric lighting company. The Gallipolis Company sells gas stoves, of any sort, at the price of the stoves to the Company.

Miss Anna Barrows has been retained by the Salem (Mass.) Gas Light Company to give a series of lectures on cooking by gas—perhaps it would be closer to the truth to say that Miss Barrows will demonstrate, rather than lecture upon, how gas may be utilized in the homes of Salem as a substitute for solid fuel in the days of heat that are to come. The course is catalogued for four demonstrations: At 3 P.M. of the first and third Tuesdays of May, and at 7:30 P.M. of the second and fourth Tuesdays of the current month.

Mr. Ralph Woodward, Superintendent of the New Rochelle (N.Y.) Gas and Fuel Company—a property of the American Gas Company—reports that Mrs. Gesine Lemcke, of New York, has completed, at New Rochelle, a most successful series of demonstration examples of how to cook by gas. The demonstrations, which were made at 2:30 P.M. of the afternoons of April 26, 27 and 28, were attended by the very best housewives of New Rochelle, and Woodward and his Company are more than satisfied over the results of Mrs. Lemcke's cleverly spoken "talks."

The proprietors of the Brockton (Mass.) Gas Light Company, as was intimated by us last week would be the case, have determined to rebuild their plant. It is estimated that $50,000 will be required to carry out the plans of the Directors.

Col. Jeremiah Coveney, Postmaster of Boston, Mass., and at one time (1891–2) a member of the Massachusetts Board of Gas and Electric Light Commissioners, died at his home in Cambridge, Mass., on the evening of April 29th. He was in his 47th year, and was well liked by those who knew him best.

After a careful looking over the field, those who proposed the construction of a gas works at Warwick, N. Y., have decided not to go on.

On June 19 the voters of Tyrone, Pa., will ballot upon the question as to whether or not that place shall acquire and operate a gas and water works plant on municipal account.

It is not at all unlikely that important changes will shortly be reported in the ownership of the Waltham (Mass.) Gas and Electric Light Company's possessions.

It looks that a gas supply for Lonaconing, Md., will shortly be arranged for. The place is too small for anything but an unambitious electric lighting concern.

The authorities of Georgetown, Ky., have a municipal gas plant on their hands, and they would like to dispose of it.

The Baltimore (Md.) *Herald*, of the 1st inst., had this to say:

"James Brady vs. The Consolidated Gas Company, of Baltimore. This suit was brought by Brady to recover for the death of his daughter. Mr. Brady's daughter was found dead in the cellar of her house, and the plaintiff complained and sued the Company on the ground that the leakage of gas that caused the death of the child was due to the negligence of the Company. The child was found dead in the cellar of a house on East Chase street, October 11, 1893. The supply pipe came in 1 foot from the floor of the cellar, and the plaintiff, Brady, was in the habit of having coal dumped in the cellar. The court below ruled that there was no evidence to show that the death of Miss Brady had been from the negligence of the Company, and, judgment being in favor of the Company, Brady appealed. The Court of Appeals affirms the judgment in favor of the Company. Opinion by Judge Russum."

Cement Protection Against Rust.

Thomas P. Roberts, Chief Engineer of the Monongahela Navigation Company, of Pittsburgh, has recorded in a letter to Chess Brothers of the same city some very interesting observations which have a bearing on the use of steel and iron in connection with concrete in building operations:

It is a matter of common observation among engineers and others who have had occasion to demolish work where hydraulic cement had been used in the original construction to find that any metal in the form of nails, bolts, etc., found imbedded in the mortar was in a perfect state of preservation. Where this is not the case it is owing to causes not due to the cement, such as cracks, etc. Even where iron or steel so imbedded had originally polished surfaces the exclusion of the atmosphere by the cement has preserved the original gloss, sometimes perfectly. In other words, a cement protection may be said to either perfectly preserve or greatly impede natural decomposition of metals.

All building cements are of an alkaline nature and hence in common parlance "hostile" to acids—*i. e.*, ready to neutralize acids. They are also absorbents of moisture, or, more correctly speaking, utilizers of moisture for their own (chemical) needs. After cement has once set, however, it is more or less inert or natural; but can be said when so inert to have certainly no affinity for vegetable or metallic substances. Aluminum may be among the possible exceptions to commercial metals not affected by close contact with cement mixtures. Hence it follows wherever metals—and I will add to this wood work also—are covered with cement mortar they are protected more or less perfectly from rust or decay. This rule applies to objects so imbedded in cement whether above or below surface of water, for it must be the case that so long as the element oxygen is kept from contact with wood or metal surfaces their decay or rust is impossible. To illustrate I will mention an easy experiment. Place polished disks of iron or steel in a jar of water from which the uncombined oxygen of the water has been absorbed with permanganate of potash. No matter how long said jar is tightly sealed the metal surface will remain perfectly bright. But once remove the stopper—even for a single instant—oxygen from the air descends in a twinkling (invisible to the eye through the water) and in a few hours the disks will begin to tarnish.

In 1861 the Navigation Company had occasion to repair the walls of one of their locks. That portion of the chamber known as the "wet belt"—*i. e.*, the courses of masonry involved in the lock lift, alternately wet and dry in the process of locking—was sheeted over with two courses of oak plank spiked to vertical timbers let, for the purpose, in the walls. Cement grout was then poured in behind the planks so that the little space between the planks and the wall was filled, the backing being imbedded in cement. It was thought this planking would have to be renewed in a few years—the "durability" of ordinary fences, no doubt, giving the idea. In this case, however, decomposition never set in, and the plank facing, now 35 years old, is still intact, though the face next the lock is badly battered, of course, by the attrition of thousands of vessels annually. Who could imagine that without the cement to preserve both the wood and the spikes these planks would have lasted so long!

Another case, and this under my own observation: In 1891 our men in overhauling some masonry work which had been permanently submerged beneath the surface for 43 years, found imbedded in the old cement morsar and only 4 inches from the face of the wall, a mason's "point" of octagonal steel ¼-inch diameter by 10 inches long, which had evidently been lost by one of the original workmen in 1848. What most astonished me was to observe that the point proper and the batter end of the tool were as bright as a new silver dollar, or certainly as bright as it was the last day it had felt the impact of the mason's mallet or hammer.

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MONDAY, MAY 10, 1897.

The Market for Gas Securities.

At time of writing (noon, Friday) the news that Governor Black had signed the graded gas bill was received. On receipt of the information at the Exchange, Consolidated advanced to 164, and we have no doubt that it will speedily go on to the highest figure yet recorded for it. All other city gas shares are strong. New York and East River common is 60 bid, and Standard common has finally reached par and over; Mutual is 245 bid, and Equitable is 216 bid. From our point of view all classes of city gas shares are cheap at the reported bid prices, with Consolidated and Mutual likely affording the most profitable opportunities. Brooklyn Union moved up to 109¼, on the declaration of the semi-annual dividend of 3 per cent. and the signing of the contract by Mayor Wurster and Commissioner Willis for a graded rate in Brooklyn.

Chicago gas is 83½, on the declaration of the regular quarterly dividend of 1½ per cent., and on the likelihood that legal consolidation of all the gas interests of Chicago is in a fair way to being achieved. Bay State is neglected, at 9 to 9½, and Baltimore Consolidated is also dull and unsteady, at 57¼ to 58½. Consumers, of Jersey City, is 75 to 80, and the bonds of the Company are 100 to 101 ex. interest. The new stock of the San Francisco Gas and Electric Company is 94 bid, despite a desperate effort on the part of local bears to depress it through the claim that important opposition will shortly be established in respect of its electric lighting trade.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

MAY 10.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,420,000	100	164	164¼
Central	500,000	50	195	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	216	..
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	245	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	85	.
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	60	61
Preferred	2,000,000	100	89	91
Bonds 1st 5's	3,500,000	1,000	100	100⅛
" 1st Con. 5's	1,500,000	..	102	103
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	100	101
Preferred	5,000,000	100	116	120
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	113
Yonkers	200,650	50	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	109¼	109⅝
" " Bonds (5's)	15 000,000	1,000	110⅛	..*
Bay State	15,000,000	50	9	9¼
" Income Bonds	2,000,000	1,000	..	35
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	85
2d " " "	3,000,000	1,000	70	72
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	98	..
Chicago Gas Co.	25,000,000	100	83⅛	83¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,000,000	..	72	74
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	100	101*
Cincinnati G. & C. Co.	8,500,000	100	201¾	202
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	57¾	58¼
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	.	22	..
" Con. Bonds	4,312,000	..	72½	74
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	81	83
" Bonds	2,000,000	..	89	92
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	132	135
" Bonds, 6's	2,650,000	..	105½	107½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	84	88
Bonds	1,000,000	1,000	92	95
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	22¼	22⅝
Preferred	2,500,000	100	73	.
Bonds	2,034,400	1,000	95	95½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	53½	54
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10.000,000	100	94	94⅛
St. Paul Gas Light Co.	1,500,000	100	79	81
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	.
Western, Milwaukee	4,000,000	100	65	67
Bonds, 5's	3,556,000	.	94	95½
Wilmington, Del.	550,000	50	200	202

*Ex-interest.

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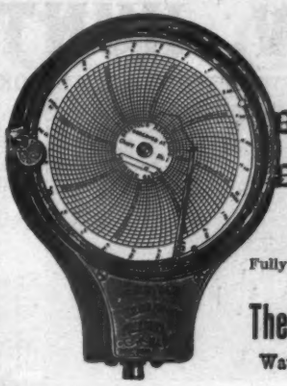

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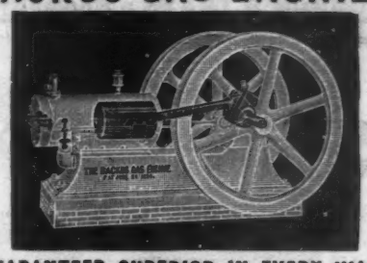

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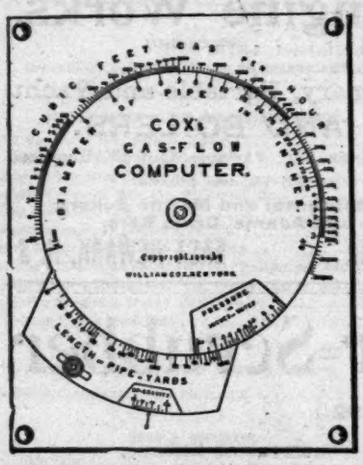

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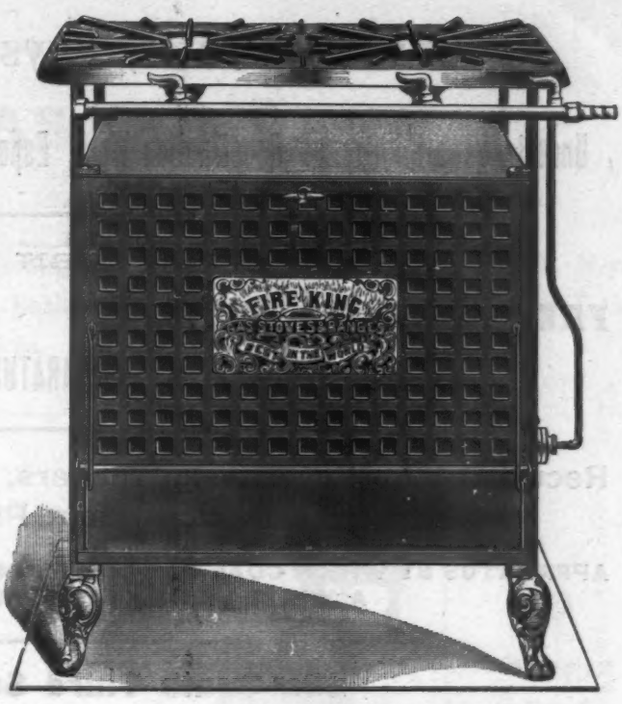

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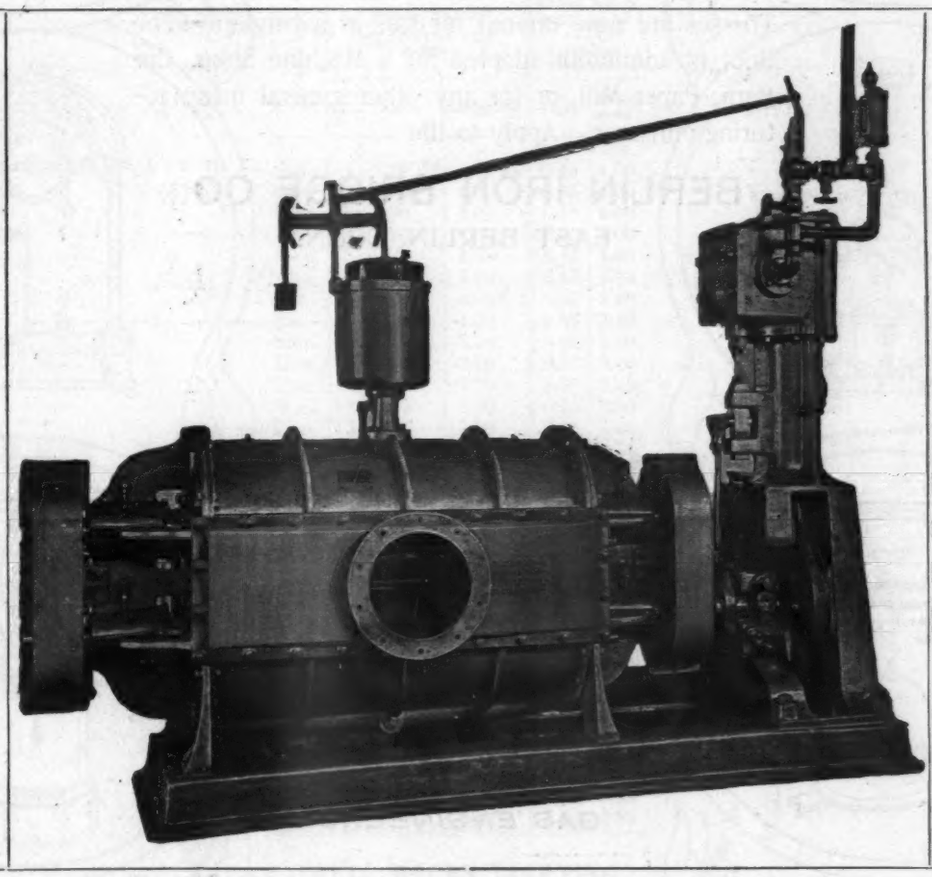

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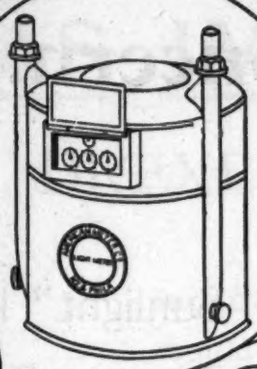

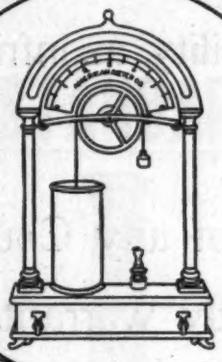

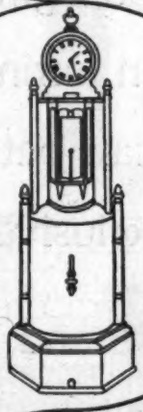

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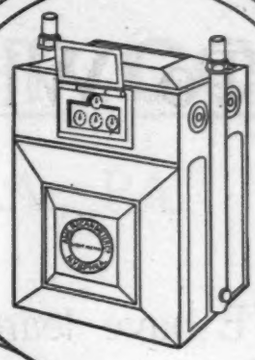
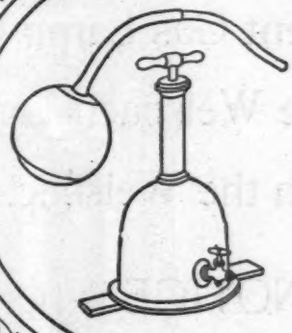
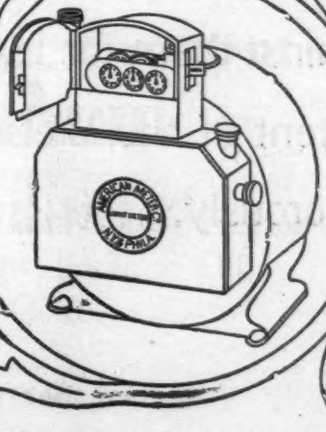
				P.M.	A.M.
Sat.	1	7.20 PM NM	4.00 AM	6.45	4.00
Sun.	2	7.30	4.00	6.45	4.00
Mon.	3	7.30	4.00	6.45	4.00
Tue.	4	7.30	4.00	6.45	4.00
Wed.	5	7.30	4.00	6.45	4.00
Thu.	6	10.40	4.00	6.45	4.00
Fri.	7	11.10	4.00	6.55	3.40
Sat.	8	11.50	4.00	6.55	3.40
Sun.	9	12.10 AM FQ	3.50	6.55	3.40
Mon.	10	12.40	3.50	6.55	3.40
Tue.	11	1.10	3.50	6.55	3.40
Wed.	12	1.30	3.50	6.55	3.40
Thu.	13	2.00	3.50	6.55	3.40
Fri.	14	No L.	No L.	7.00	3.30
Sat.	15	No L. FM	No L.	7.00	3.30
Sun.	16	No L.	No L.	7.00	3.30
Mon.	17	7.40 PM	10.10 PM	7.00	3.30
Tue.	18	7.40	11.10	7.00	3.30
Wed.	19	7.40	12.00 AM	7.00	3.30
Thu.	20	7.40	12.40	7.00	3.30
Fri.	21	7.40	1.10	7.10	3.15
Sat.	22	7.40 LQ	1.40	7.10	3.15
Sun.	23	7.50	2.00	7.10	3.15
Mon.	24	7.50	2.20	7.10	3.15
Tue.	25	7.50	2.40	7.10	3.15
Wed.	26	7.50	3.00	7.10	3.15
Thu.	27	7.50	3.40	7.10	3.15
Fri.	28	7.50	3.40	7.15	3.15
Sat.	29	7.50	3.40	7.15	3.15
Sun.	30	7.50 NM	3.30	7.15	3.15
Mon.	31	7.50	3.30	7.15	3.15

TOTAL HOURS LIGHTING DURING 1897.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	233.00	January	423.20
February	187.20	February	355.25
March	202.00	March	355.35
April	170.40	April	298.50
May	163.00	May	264.50
June	140.40	June	234.25
July	151.40	July	243.45
August	167.30	August	280.25
September	174.40	September	321.15
October	200.00	October	374.30
November	205.20	November	401.40
December	220.10	December	433.45
Total, yr.	2216.00	Total, yr.	3987.45







To Whom It May Concern.

WE have learned that the makers of the "Sunlight" lamp assert that there has been a decision in the English Courts which saves them and their customers from liability as infringers of the Welsbach patents.

We assure the public there is no decision of any Court, in England or elsewhere, that directly or indirectly warrants the statement or inference that the lamp sold by the Sunlight Incandescent Gas Lamp Company of America is not an infringement of the Welsbach Light as made under the American patents, of which the Welsbach Light Company is sole and exclusive owner.

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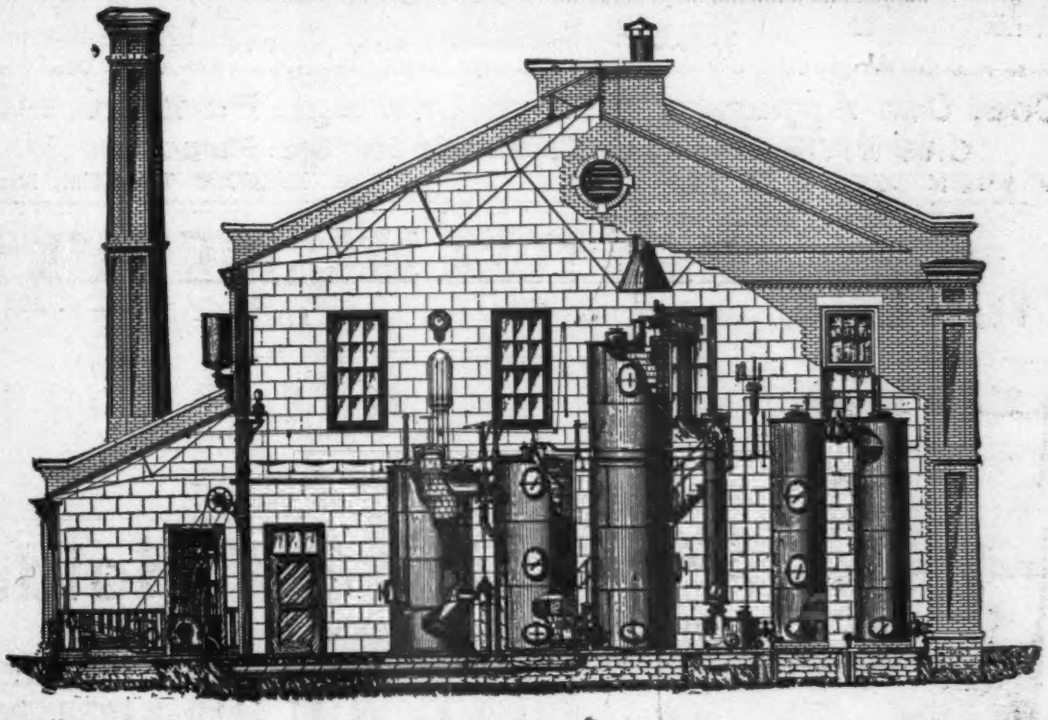

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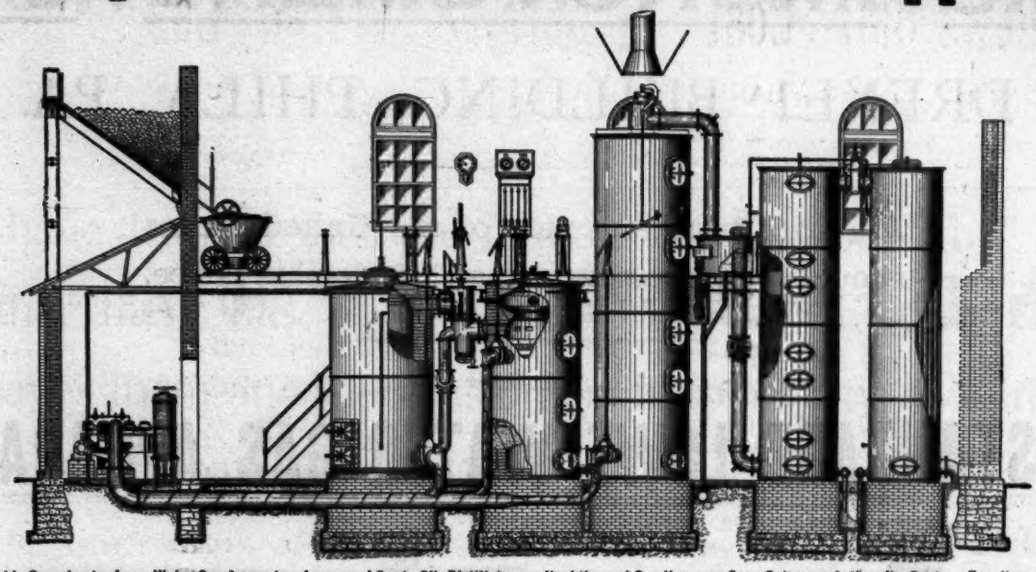

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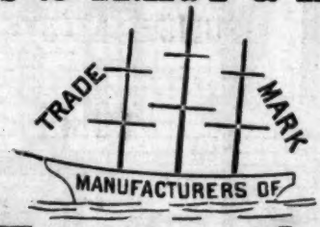

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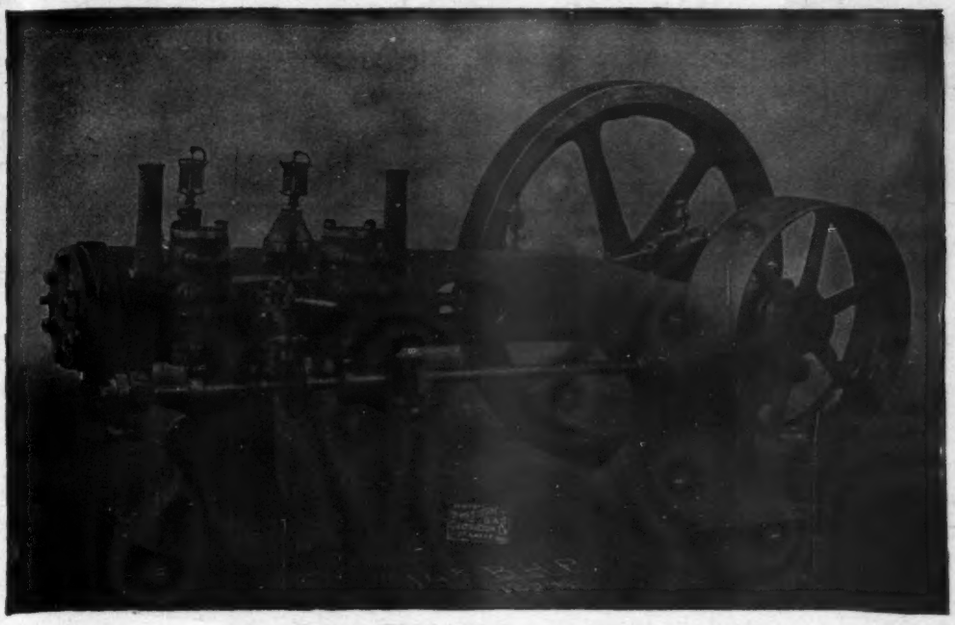

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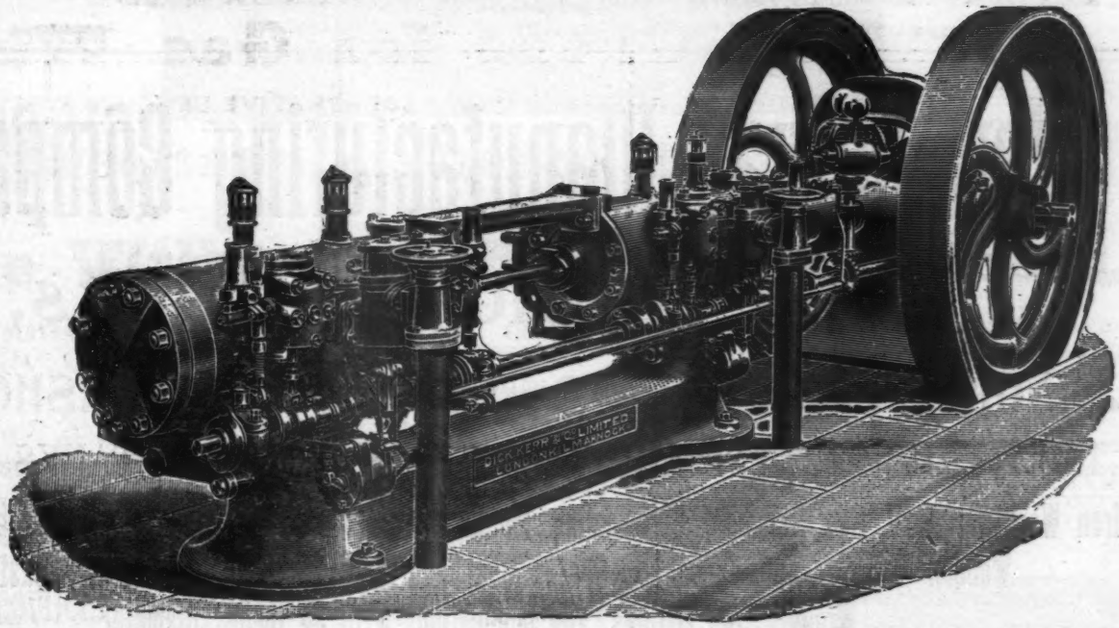

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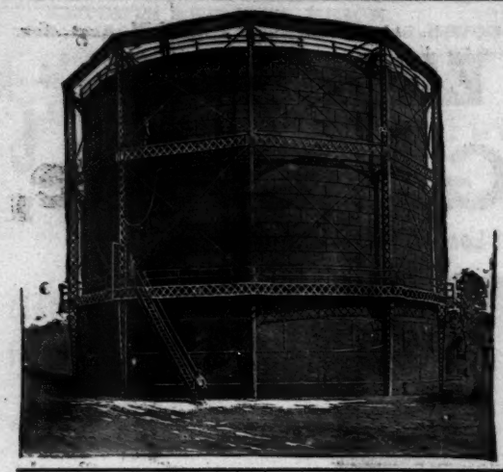

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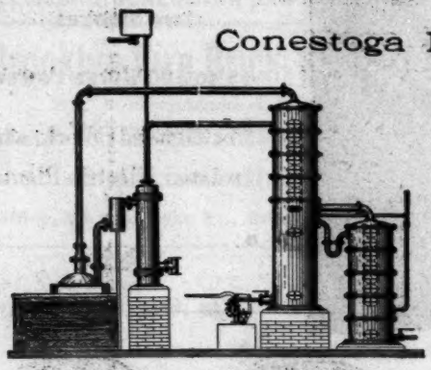

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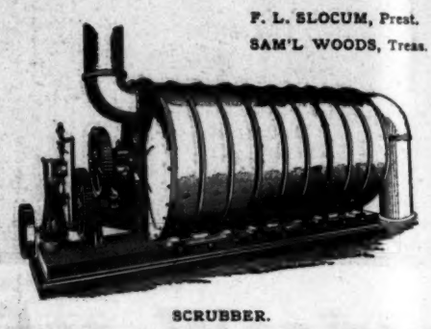

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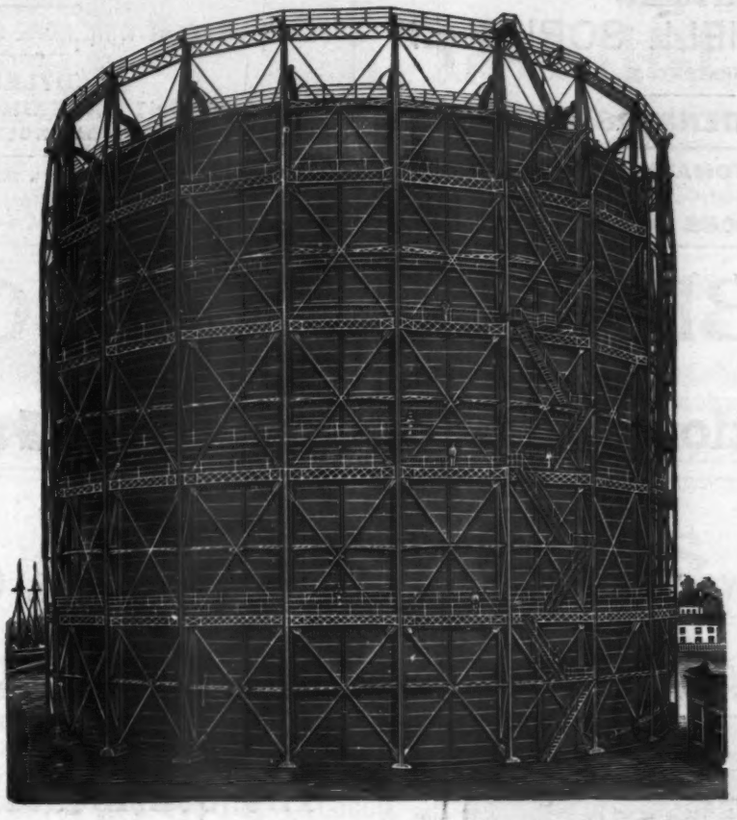

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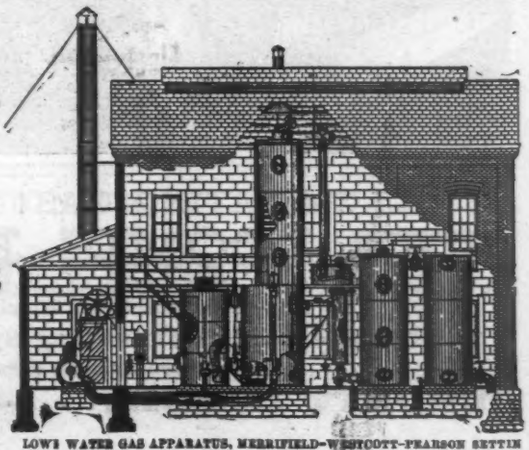

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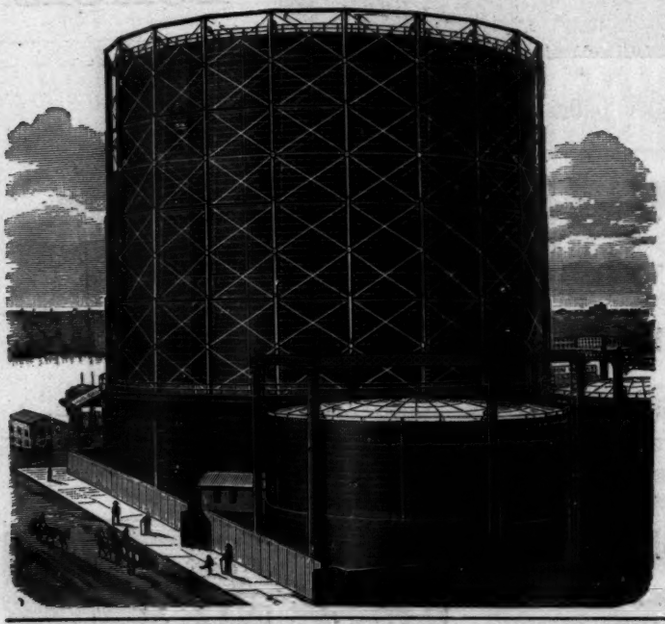

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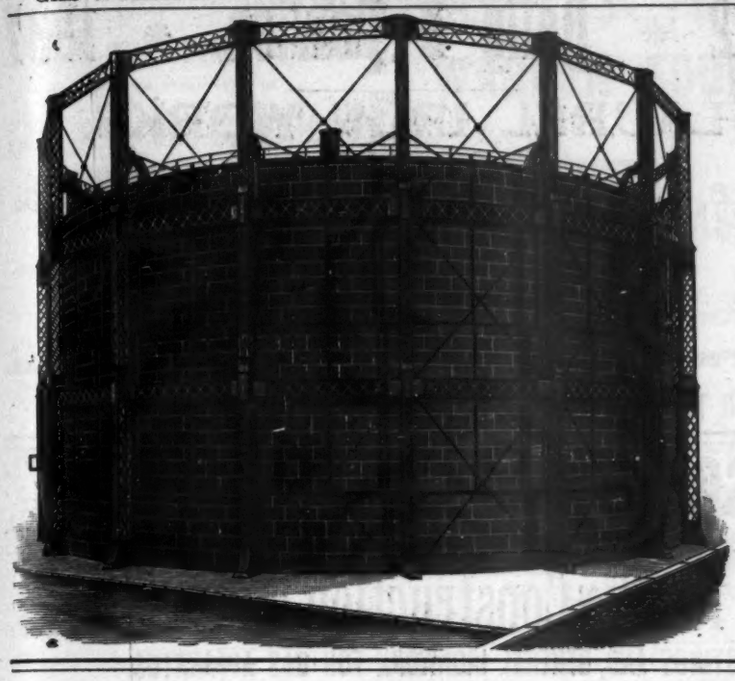

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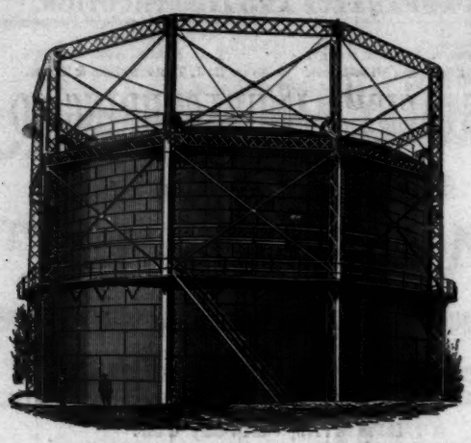

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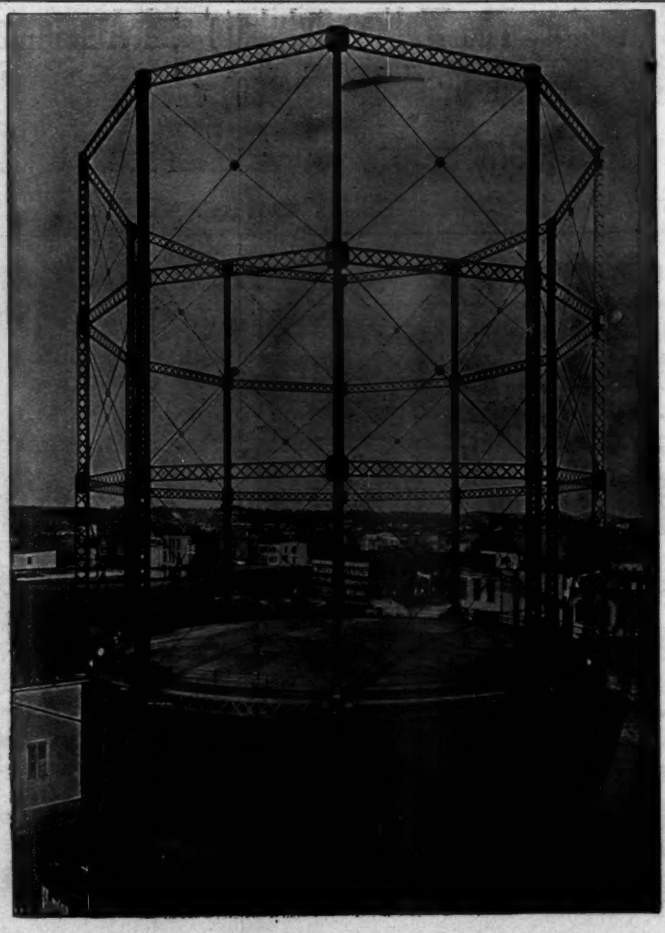

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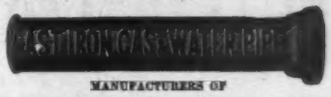

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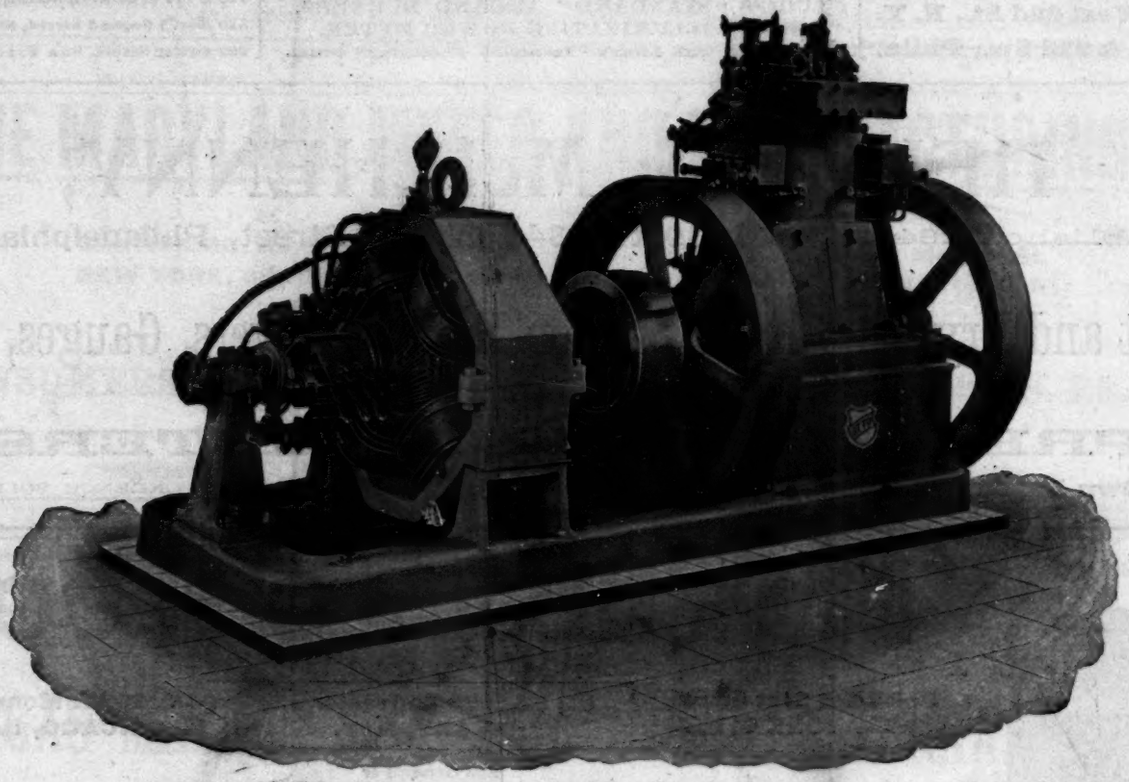

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